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Water Plant Optimization Study

# TORONTO EASTERLY WATER TREATMENT PLANT

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# Water Plant Optimization Study

## Toronto

## Easterly Water Treatment Plant

## Project No. 7-2016

**December 1990**

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# SUMMARY OF FINDINGS AND RECOMMENDATIONS

## 1.0 INTRODUCTION

This report on the Toronto Easterly Water Treatment Plant Optimization Study was prepared by MacLaren Engineers Inc. on behalf of the Ontario Ministry of the Environment under Agreement dated October 8, 1987.

The project is a result of the Drinking Water Surveillance Program (DWSP) being carried out by the Ministry of the Environment on municipal water supplies. Under this program, which began on April 1, 1986, a continuously updated base of information is being established on Ontario water plants and water quality. The Water Plant Optimization Study (WPOS) program was initiated for each plant entering the program in order to complement the data generated from the Drinking Water Surveillance Program.

The study approach and detailed Terms of Reference for the Water Plant Optimization Study were prepared by the Ministry of the Environment. The purpose of the study is to document and review present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on the removal of particulate materials and disinfection processes.

To maintain a current database of information, it is envisaged that the WPOS report will be updated on an annual basis.

As a supplement to the Water Plant Optimization Study for the Toronto Easterly Water Treatment Plant, a separate report was prepared on the existing waste management practices at the plant. The report provides an overview of the existing treatment facilities and includes sections on sources of wastes, waste characteristics, present disposal practice and estimates of capital and operating costs for the existing treatment works. The report was prepared by MacLaren Engineers Inc. for the Ministry of the Environment under the title: Wastewater Disposal Study, Toronto Easterly Water Treatment Plant, August, 1988.

# 2.0 HIGHLIGHTS OF STUDY

## 2.1 Raw Water Quality

The Easterly Treatment Plant in the City of Scarborough draws water from Lake Ontario through a bell mouth intake located about 3 km offshore in 18 m of water. The lake water is generally of good physical and chemical quality and is characterized by low average levels of turbidity, in the order of 1.3 FTU, and low colour content of 2.5 TCU. Average monthly variations in these parameters are also low. Maximum daily turbidity values varied from 0.3 to 20 FTU, but higher values have not affected the operation of the plant. The water has moderate levels of alkalinity and hardness, and pH value that normally is above 8.0 units. During the summer months a maximum pH value of 8.5 units has been observed.

Bacteriological water quality data for total and fecal coliform indicator organisms indicate that the source water was polluted and that the contamination was of fecal origin. The degree of pollution varied during the year and was lower during the summer than during the winter.

During the summer months significant numbers of algae were present in the raw water which affected the operations of the filters by reducing the normal length of filter runs by about 60 percent. The dominant species included Asterionella, Fragilaria, Melosira, Microspora, Oscillatoria, Stephanodiscus and Tabellaria; all are known to have filter clogging characteristics.

## 2.2 Flow Measurement Accuracy

Venturi tube flow meters are used for measuring the plant's main process flows. Although these primary flow meters are known to be very accurate, the maximum range in flow meter error was established as being anywhere from ±1.6 to ±3.0% as a result of cumulative errors arising from flow meter instrumentation and the use of multiple meters.

## 2.3 Plant Capacity and Process Design

The Easterly Filtration Plant and associated works were constructed from 1974 to 1979 with a plant capacity of 454,600 $m^3/d$.

The plant utilizes the direct filtration treatment process consisting of chemical coagulation and flocculation followed by dual media filtration. Coagulation is achieved in mechanical in-line blenders, while flocculation is achieved in two modules of in-line pipe flocculators and two modules of mechanical, three-stage, turbine flocculators suitable for tapered flocculation. Each pretreatment module has a design capacity of 25 percent of the design flow.

Chemical treatment processes consist of coagulation with alum (and recently polyaluminum chloride), disinfection using gaseous chlorine, fluoridation using liquid hydrofluosilicic acid, and ammoniation of the treated water with the addition of aqua-ammonia. Gaseous chlorine in solution form is applied in the prechlorination and postchlorination modes. The mode of postchlorination used is either ordinary (also known as conventional) or superchlorination. The latter mode is used when the free ammonia content in the raw water exceeds a pre-determined level in order to safeguard against the possible presence of higher than normal levels of bacterial pollution in the raw water and to control any tastes and odours, if present. Following postchlorination, the water is dechlorinated using sulphur dioxide gas.

Filter backwash water is treated for solids separation in two circular solids-contact clarifiers. The settled sludge is pumped to the Highland Creek Pollution Control Plant for further treatment and disposal while clarified overflow is discharged to a creek to the east of the plant.

With regard to plant capacity, there are no limitations to achieving the design flow rate of 454,600 $m^3/d$, which, in fact, has been exceeded during the peak demand period in each of the three years investigated. The presence of algae in the raw water reduce the length of filter runs

but, at the levels encountered, have not had any adverse impact on the turbidity of the filtered water.

## 2.4 Process Automation

The Easterly Filtration Plant includes a computer-based monitoring and control system comprising a digital computer and all peripheral hardware and software that will permit the plant to be operated automatically and also manually.

Serving as back up to the process controller, the plant is equipped with a complete analogue supervisory and control system, as well as local supervisory and control panels. A remote telemetering supervisory and control system has been provided for remote manual control of the treated water pumps from Central Pumping Control in the distribution system.

## 2.5 Plant Operations

Normally the plant is operated by two operators - the Filter Plant Operator (FPO) and his assistant, the Filter Plant Assistant (FPA). The FPO runs the plant in a remote manual mode from the process controller. He will select raw water pumps to essentially match the flow rate of the treated water pumps. The treated water pumps are normally selected remote manually from Central Pumping Control but can be operated from the process controller. Treatment modules, and associated equipment, are selected by the FPO depending upon raw water flow.

The filters are operated automatically at constant rate and are controlled by the level in the prefiltered water conduit. Filters are monitored by on-line instrumentation for flow, head loss and effluent turbidity. Two filters are equipped with multi-head loss and media interface turbidity measurement instrumentation. The head loss signal (or filter effluent turbidity) is used to automatically initiate the backwash program, which is resident in the process controller. Upon

completion of a backwash and a 15-minute rest period, the filter is automatically returned to service.

Chemical feeders are operated in a semi-automatic mode through the process controller. Qualitative control of applied dosages is remote manual by setting feed rates from the process controller, while quantitative control is automatic through proportional-to-flow controllers.

The FPA is the roving operator who monitors plant operations, collects manual water samples for analysis in the laboratory, does taste tests on the treated water, confirms the accuracy of on-line monitors, receives chemicals, and makes physical changes to valves and equipment to attain the desired operating mode established by the FPO.

## 2.6 Process and Quality Control

Process and quality control is the responsibility of the FPO who maintains hourly records of flows, chemical consumption and results of quality control testing. Analytical testing and water examination for biological and bacteriological parameters are carried out in the plant laboratory. The laboratory is staffed by the chief chemist, a chemist and two chemist assistants.

# 3.0 PLANT PERFORMANCE

## 3.1 Particulate Removal

Treatment plant performance with regard to particulate removal during the three-year study period was found to be very good. For instance, the average monthly turbidity levels in the treated water ranged from 0.15 to 0.24 NTU in 1986, 0.16 to 0.27 NTU in 1985 and 0.11 to 0.28 NTU in 1984. The yearly average values for the three respective years were 0.19, 0.21 and 0.16 NTU.

The removal of turbidity on a daily basis was also found to be very good. For the three-year record, the daily average turbidity in the

treated water was in the order of 0.20 NTU and the minimum and maximum values recorded were 0.08 and 0.36 NTU respectively. The highest quality water was achieved during April 1984 for which the average effluent turbidity was 0.12 FTU and the lowest daily average was 0.08 NTU.

Our review of plant performance during periods with higher than average raw water turbidities revealed that:

i) filter effluent turbidities were low for the entire duration of adverse raw water quality conditions. Effluent turbidity values ranged from 0.09 to 0.28 NTU and the overall average was 0.15 NTU;

ii) at no time was the drinking water objective for turbidity of 1.0 NTU exceeded in the filtered water, and, in fact, never went above 0.3 NTU.

During 1986 the monthly average length of filter runs varied from 22 to 56 hours, and the yearly average was 41 hours. The presence of elevated levels of algae in the raw water during July reduced the average length of filter runs by about 60 percent.

Filter backwash water consumption during 1986 varied from 1.1. to 2.7 percent of the total water filtered; the average for the year was 1.84 percent. A maximum wash water consumption of 3.17 percent was incurred on July 10, 1986 as a result of a very high hydraulic loading rate on the filters (524.3 ML/d) and an algae content in the feed water of 838 A.S.U. per mL.

Three jar tests were performed on a raw water sample obtained from the plant on February 3, 1988. Two of the tests were done with polyaluminum chloride (PACl) as the coagulant and one with alum. Standard jar test procedures were used in the tests except that flocculated test samples were not settled but filtered through a laboratory filter paper. Performance was judged on the basis of the turbidity achieved in the filtrate. The results of the tests showed that for a raw water

with turbidity of about 0.9 NTU, pH of 8.16, and temperature of 1.0 to 1.5°C, the optimum PACl dosage for coagulation was 0.6 to 1.2 mg/L and that for alum was 3.0 to 4.0 mg/L. The result for alum was similar to the dose applied at that time in full-scale treatment.

## 3.2 Disinfection

Prechlorination was practiced at an average dosage of about 0.80 mg/L chlorine which resulted in an average free chlorine residual after the filters of ≤0.50 mg/L over the entire study period. The chlorine contact time at the design flow rate is 58 minutes with mechanical flocculations and 27 minutes with in-line flocculations.

The total chlorine residual is monitored in the plant output by an on-line automatic analyzer. The average total chlorine residuals were 0.75 mg/L for each of 1986 and 1985, and 0.72 mg/L for 1984; the range for the three-year period was 0.66 to 0.82 mg/L. The contact time in the clear well at the design flow rate is 1.27 hours. An additional but variable amount of contact time of 1.3 to 3.7 hours is provided by the reservoir.

In the post-treatment mode superchlorination is used when the raw water is suspect of being highly contaminated with microorganisms, or when taste and odour is present. Dechlorination is practiced on a continuous basis by the addition of sulphur dioxide to maintain a free chlorine residual of 0.45 to 0.65 mg/L.

Based on the bacteriological test results for raw and treated water, it was concluded that the disinfection practice at the Easterly Filtration Plant was very efficient and that no immediate improvements need to be made to the process. A downward adjustment of the high raw water pH during the summer could be considered to improve the efficiency of disinfection.

## 3.3 Taste and Odour Control

Filtered water and plant output are tested hourly by the operator for taste characteristics. Superchlorination is used to control

chlorophenol tastes whereas the postchlorine dosage is adjusted in case of the presence of earthy, foul or weedy tastes. The practice has been found very successful in controlling tastes, although an increase in tastes has been experienced occasionally in the distribution system.

### 3.4 Fluoridation

The treated water is fluoridated using hydrofluosilicic acid to achieve a fluoride residual of 1.0 to 1.2 mg/L in the plant output. This objective has been met in 1986 and 1985, and, on an average basis, also in 1984.

### 3.5 Aluminum in Treated Water

The average dissolved aluminum content in the treated water was 0.094 mg/L in 1986, 0.119 mg/L in 1985, and had a range of 0.050 to 0.148 mg/L over the two years. For the same period, the treated water pH had an average value of 7.55 units and the range was 7.4 to 7.7 units.

The aluminum residuals in the plant output were in general quite low and are less than the equilibrium value of 0.34 mg/L theoretically attainable in a pure system at pH of 7.55.

### 3.6 Stability of Water

On the basis of the Langelier Saturation Index it was determined that the water is slightly aggressive after treatment.

## 4.0 RECOMMENDATIONS

### 4.1 Physical Improvements

No physical improvements need to be undertaken at this time to improve operations at the Easterly treatment plant with respect to particulate removal and disinfection.

## 4.2 Studies

### 1. Chemical Coagulant

Polyaluminum chloride has been used by plant personnel as the chemical coagulant since September 1986. A preliminary assessment of its effectiveness would indicate that the product is as effective as and, perhaps, more effective than alum with certain raw water quality. In this regard therefore, it is recommended that a summary report be prepared on this trial period which would document the operating record and include evaluations on the performance and behaviour of PACl as the chemical coagulant at the Easterly treatment plant.

### 2. Flocculant Aid

Investigate the effectiveness and benefits of using a cationic or non-ionic polyelectrolyte as a flocculant aid, especially for use during the cold weather periods of the year, in order to increase the performance of the coagulation process.

### 3. Adjustment of System pH

Carry out studies to establish whether pH adjustment of the raw water, with final readjustment of the treated water, should be implemented in order to optimize the performance of the coagulation process.

### 4. Filter Aid

Investigate the benefits of using a non-ionic polyelectrolyte as a filter aid in the treatment process to increase the performance of the filters.

### 5. Filter Conditioning

#### a) Conditioning of Backwash Water

Continue investigations into the feasibility and effectiveness of pre-conditioning a filter during the backwash using a non-ionic polymer

or inorganic coagulant to reduce the level and duration of the initial high turbidity during the filter ripening period.

b) Slow Start-Up of Filter

Investigate the effect of a slow start-up of a filter at uniform rate over a 10 to 30 minute period on filter performance during the ripening period.

c) Filter to Drain

An alternative method for conditioning a filter to improve filter effluent quality immediately after start-up is to filter to drain. This procedure should be investigated, at reduced filter rates, using the manually controlled filter drain pipe.

6. Corrosiveness of Treated Water

Establish the corrosiveness of the treated water and determine whether corrective measures need to be implemented.

4.3 Long-Term Modifications

In-line pipe flocculators were shown to have a much lower Gt product compared with mechanical flocculators. Studies should be carried out to assess what effect, if any, the lower Gt product has on the efficiency of flocculation and the resultant filter effluent turbidity.

## ACKNOWLEDGEMENTS

Members of the Project Committee for the Toronto Easterly Water Treatment Plant are listed on the fly-sheet of this report. The cordial assistance provided by each of these members during the course of this study is hereby gratefully acknowledged. To all others who have assisted us in any way, we express our sincere thanks.

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# LIST OF SYMBOLS AND ABBREVIATIONS

## Symbols Used

| | |
|---|---|
| d | day |
| h | hour |
| min. | minute |
| s | second |
| m | metre |
| mm | millimetre |
| cm | centimetre |
| $m^2$ | square metre |
| $m^3$ | cubic metre |
| L | litre |
| mL | millilitre |
| kg | kilogram |
| mg | milligram |
| µg/L | microgram per litre |
| L/h | litre per hour |
| L/min. | litre per minute |
| L/s | litre per second |
| m/s | metre per second |
| m/h | metre per hour (filter rate or surface overflow rate equal to $m^3/h.m^2$) |
| $m^3/d$ | cubic metre per day |
| kg/h | kilogram per hour |
| °C | degree Celcius |
| FTU | Formazin turbidity unit |
| NTU | Nephelometric turibidity unit |
| ACU | apparent colour unit |
| TCU | true colour unit |
| A.S.U. per mL | areal standard units per millilitre (ASU/mL) |
| $s^{-1}$ | mean velocity gradient, metre per second per metre |
| rpm | revolution per minute |
| V | volt |
| A | ampere |
| kVA | kilovolt ampere |
| kW | kilowatt |
| > | greater than |
| < | less than |
| % | per cent |

## Abbreviations Used

| | |
|---|---|
| DWSP | Drinking Water Surveillance Program |
| MOE | Ontario Ministry of the Environment |
| WPOS | Water Plant Optimization Study |
| FPO | Filter Plant Operator |
| FPA | Filter Plant Assistant |
| C-M-A | Computer-Manual-Automatic electronic process controller |
| C-M | Computer-Manual electronic process controller |
| Al | aluminum |
| Alum | aluminum sulphate solution |
| $CaCO_3$ | calcium carbonate |
| $Cl_2$ | chlorine |
| N | nitrogen |
| $NH_3$ | ammonia |
| $SO_2$ | sulphur dioxide |
| PACl | polyaluminum chloride |
| E.S. | effective grain size |
| U.C. | uniformity coefficient |
| L.I. | Langelier Saturation Index |
| MF | membrane filter technique for enumerating bacteria in water |
| pH | expresses the intensity of the acid or alkaline condition of a solution |
| p.f. | power factor |
| SWD | side water depth |
| THM | trihalomethane |
| TTHM | total trihalomethane |

# SECTION A

# INTRODUCTION, TERMS OF REFERENCE AND

# RAW WATER SOURCE

## SECTION A - INTRODUCTION, TERMS OF REFERENCE AND RAW WATER SOURCE

### A.1 BACKGROUND

The Ontario Ministry of the Environment has instituted a Drinking Water Surveillance Program. The Program began on April 1, 1986 and encompasses all municipal water supplies in Ontario. The primary objectives of the DWSP for Ontario are to establish a reliable database on water quality which will encompass a wide range of parameters, including pesticides and organic compounds, and to maintain information current by continuously updating the database. In connection with the DWSP, a plant investigation and process evaluation study is initiated for each plant entering the program. A major goal of the study is to document information on the plant's process design and operations, and to determine an optimum treatment strategy for contaminant removal at the plant. It is intended to update the study on an annual basis in order to maintain the database current. The information from these studies will allow valid water quality data to be collected. The results will further identify potential problem areas, serve as the basis for remedial action, and provide a framework for defining contaminant levels and trends.

### A.2 TERMS OF REFERENCE

A detailed protocol for the Water Plant Optimization Study has been prepared by the Ministry for use by the consultants engaged for the optimization studies. This study of the Grimsby Water Treatment Plant has been conducted in accordance with the protocol. The main objective of the plant investigation and process evaluation study is:

> *"To review the present conditions and determine an optimum strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes."*

To meet this objective, Terms of Reference were prepared by the Ministry (and later re-issued as Rev. 1 on 06/04/87) consisting of eight specific work tasks which require the consultant to examine, in

three years of daily and monthly operating data, to prepare a comprehensive assessment of plant operations and the level of performance achieved, and to provide recommendations for short and long term modifications in order to obtain optimum disinfection and contaminant removal. The complete revised Terms of Reference are included at the end of this report as Appendix D.

As a supplement to the Water Plant Optimization Study, the consultant was commissioned to prepare a separate report on the handling and disposal of wastewaters generated at the plant.

## A.3 RAW WATER SOURCE

### a) Source

The Easterly Filtration Plant in Metropolitan Toronto is located on the shoreline of Lake Ontario in the City of Scarborough. Water is drawn from the lake via a 3,353 mm diameter concrete-lined tunnel extending some 3,210 m into the lake. The bell mouth intake, constructed of fabricated steel, is located in 16.4 m of water and has a minimum depth of submergence of 10.6 m.

### b) Quality

Lake Ontario water in the region of the Easterly Filtration Plant intake, generally is of good quality. Extensive records are being kept by the plant. Those for the period 1984 to 1986 are presented in the protocol tables for the Optimization Study attached as Appendix C to this report. A summary of the data for several parameters is presented in Table A.1 to express general water quality conditions. A more detailed discussion of various water quality parameters follows.

#### Physical Parameters

Turbidity: The average monthly turbidity varied from a low of less than 1.0 FTU to a high of 2.6 FTU. Greater fluctuations occurred in

TABLE A.1

LAKE ONTARIO RAW WATER QUALITY CHARACTERISTICS

AT THE EASTERLY FILTRATION PLANT

| | 3-Year Summary, 1984 to 1986 | |
|---|---|---|
| | Monthly Average Range | Average |
| Turbidity, FTU | 0.78 - 2.6 | 1.31 |
| Colour, TCU | 2 - 3 | 2.5 |
| pH, Units | 7.9 - 8.3 | 8.1 |
| Temperature, °C | 1.3 - 15.7 | 6.2 |
| Alkalinity as $CaCO_3$, mg/L | 83 - 97 | 91 |
| Hardness as $CaCO_3$, mg/L | 128 - 132 | 131 |
| Free Ammonia as N, mg/L | 0.001 - 0.032 | 0.011 |
| Standard Plate Count, (MF) per mL | 5.2 - 86 | 25 |
| Total Coliform, (MF) per 100 mL | 4.6 - 213 | 42 |
| Fecal Coliform, (MF) per 100 mL | 0.056 - 35 | 4.7 |
| Algae, A.S.U. per mL | 97 - 837 | 253 |

daily values which varied from 0.3 FTU to 20 FTU. The overall average for the three-year record is 1.31 FTU. The higher values of turbidity generally occurred during the period November through April.

Colour: Colour is a measure of the clarity of the water. At the Easterly plant intake, lake water colour was relatively constant. The data record indicates that raw water colour varied from 1 to 10 TCU, and that the monthly average was generally between 2 and 3 TCU.

Temperature: Raw water temperature is measured continuously on a sample drawn from the intake surge well of the raw water pumping station. Average monthly temperatures were in the order of 6 to 7°C; during July to October monthly average temperatures ranged from 6.0 to 15.7°C and the average was 10.5°C. During the year, daily extreme values of 0.5°C to 20.5°C have been observed.

Taste and Odour: Taste and odour tests are performed hourly on filtered water and the plant output. No tests are done on the raw water. During the study period no positive results have been reported for either filtered or output water.

Chemical Parameters

pH Value: The average monthly raw water pH generally is above 8.0 units and ranged from 7.9 to 8.3 units. Daily extreme values of 7.9 and 8.5 units have been observed. The greatest fluctuations occur during the algae growing season from May to September.

Alkalinity: Total alkalinity was relatively constant ranging from 83 to 97 mg/L as $CaCO_3$. The monthly average alkalinity value for the study period was 91 mg/L.

Hardness: The raw water hardness had a monthly average of 131 mg/L as $CaCO_3$. Little variation was observed in this value, which ranged from 128 to 132 mg/L. At this level of hardness the water may be classified as being moderately hard.

Free Ammonia: Since free ammonia is indicative of organic pollution, the parameter is used by the plant as a primary indicator for initiating superchlorination treatment. For this reason, raw water is sampled every two hours and analyzed for free ammonia. Monthly average values observed varied from 0.001 to 0.032 mg/L as N. Recorded daily maximum and minimum values of free ammonia for individual tests were 0.620 mg/L as N and zero.

The level of free ammonia in the raw water at which superchlorination is started is 0.02 mg/L as N.

## Microbiological Parameters

### (i) Bacteriological Water Quality

Bacteriological water quality data indicate that the source water was polluted and that contamination was of fecal origin. The degree of pollution varied over the year and tended to be lower during the summer than during the winter. For May to August the average monthly total coliform densities were less than 100 organisms per 100 mL and fecal coliform levels were less than 10 per 100 mL. However, bacterial contamination was present all the time even though there were occasions during May, June and July when the fecal coliform group test results were generally zero. Bacterial densities were found to be typically higher during the winter months. This may have been due to the influence of sewage treatment plant outfalls which were not chlorinated during that time.

As a result of these findings the Ministry of the Environment, Central Region, issued a directive in March 1988 to the Municipality of Metropolitan Toronto stating that:

> *"Commencing April 1, 1988 you are to maintain year round disinfection of plant effluents discharging to Lake Ontario".*

Normally twenty-three raw water samples per week were analyzed for bacteriological quality which included standard plate count, total

coliform and fecal coliform organisms. Once per week the raw water as tested for fecal streptococcus bacteria. A condensed summary of the bacterial test results obtained for 1984 to 1986 is given below.

Standard Plate Count: The average monthly standard plate count for 1984 to 1986 was 25 organisms per mL. This is a very low average count which did not vary widely over the year; the range in monthly averages was 5.2 to 86 per mL. On a daily basis, the bacterial density can be much higher though, and a maximum number of 1,600 per mL has been found in a single test.

Total Coliform: The range in daily total coliform counts observed during the study period was from zero to 4,400 per 100 mL; while the monthly 1986 average for April to August was in the order of 12 organisms per 100 mL and 68 per 100 mL for September to March. The 3-year monthly average count was 42 per 100 mL.

Fecal Coliform: The fecal coliform organisms, which are indicative of sewage pollution, averaged, on a monthly basis, about 5 organisms per 100 mL of raw water sample. Daily variations from zero to 400 counts per 100 mL were observed in individual tests.

Fecal Streptococcus: Test results for fecal streptococcus in the raw water were normally zero. Daily extreme values for individual test samples were found to range from zero to 4 organisms per mL of raw water sample.

(ii) Nuisance Organisms (Algae)

Normally one raw water sample per week was analyzed in the plant laboratory for algae organisms and enumerated by species. More frequent analyses are carried out during the summer months.

Monthly average algae counts observed ranged from 97 to 837 A.S.U. per mL; whereas the monthly average for the three-year record was found to

be 253 A.S.U. per mL. The daily maximum can be significantly higher as was evident from the maximum value of 2,503 A.S.U. per mL established in July 1986 for an individual test.

Dominant summer algae species include Asterionella, Fragilaria, Melosira, Oscillatoria, Stephanodiscus, and Tabellaria. These species are filter clogging, and when present in large numbers have a significant impact on the operation of the dual media filters.

# SECTION B

# FLOW MEASUREMENT

# SECTION B - FLOW MEASUREMENT

## B.1 METHOD OF MEASURING FLOWS

Flows are measured for:

- raw water - the distribution of raw water to pretreatment modules
- filter effluent - each individual filter
- total filtered water
- filter backwash water
- filter surface wash
- service water
- plant output - treated water discharged to District 1E and District 2E
- waste water to clarifiers
- settled sludge to Highland Creek Pollution Control Plant.

The primary flow element for each meter is a short form Venturi tube except for the total filtered water meter and the waste water meters, which are Ramapo strain gauge-type meters, and the settled sludge meter, which is a magnetic flow meter.

Table B.1 lists information on existing flow meters and associated instrumentation. The sizes and capacities of the various flow meters are also given.

All Venturi tube flow meters are fitted with differential pressure transmitters which supply the linear flow signal to locally and remotely mounted indicator-totalizers and recorders as listed in Table B.1.

Individual raw water flow signals are summated by the Process Controller for: 1) total raw water flow
2) combined flow for modules 1 and 2 and modules 3 and 4.

The analogue control panel includes individual totalizer-indicators for monitoring individual flow streams.

Summated flows for modules 1 and 2 and modules 3 and 4 are used for quantitative pacing of chemical metering pumps for the primary coagulant (alum/polyaluminum chloride), as well as the coagulant aid, if used. The total summated raw water flow signal is used for quantitative pacing of the pre-chlorinators and the polyelectrolyte filter aid metering pumps, if used. When the process controller is out of operation metering pumps and chlorinators are manually adjusted at the equipment.

Filters operate at constant rate filtration. The flow from each filter is measured by venturi flow meter. The flow signal is used in conjunction with the filter rate controller to match the flow set point. Individual filter flows are summated to establish the total filter flow for monitoring purposes and for the quantitative control of the post-chlorinators and the hydrofluosilicic acid feed pumps.

Originally it was intended to measure total filter flow with the Ramapo strain gauge flow meter. This meter is installed in the treated water transfer channel between the clear well and reservoir. As a result of the hydraulic flow regime in this particular installation, however, flow meter errors are produced which make the meter inappropriate for use.

Waste water flow to each clarifier is measured by a Ramapo strain gauge flow meter. Signals are transmitted to the process controller for monitoring purposes. A flow balance between the two clarifiers is achieved by manually adjusting the setting of the clarifier inlet valves. An imbalance in flow greater than 5 percent will initiate an alarm. The total waste water flow is summated by the process controller. The summated flow signal is used for control of the waste water rate control valve. The signal can also be used for pacing of coagulant feed equipment, if required. A local sludge pumping control panel includes a summator and indicating totalizer for monitoring total flow.

Settled sludge pumped to the Highland Creek Pollution Control Plant is monitored by a magnetic flow meter.

## FLOW METERING EQUIPMENT

| SERVICE | NUMBER | TYPE & CAPACITY RANGE | LOCATION | INSTRUMENTATION |
|---|---|---|---|---|
| 1. Raw Water Flow | 4 | • 914/914 mm dia. (I/O) short form Venturi tube<br>• 18,200 to 182,000 $m^3/d$ | • Raw water pretreatment modules 1 to 4 | • local: DP indicating transmitter, square root extractor and linear flow transmitter to PC and ACP<br>• remote: individual flow indicators, totalizers, the PC summats total flow, Modules 1 and 2, and Modules 3 and 4 |
| 2. Filter Flow | 8 | • 914/762 mm dia. (I/O) short form Venturi tube<br>• 13,650 to 136,000 $m^3/d$ | • Filter Pipe Gallery | • local: DP transmitter, indicator, signal to PC and ACP<br>• remote: flow summation by PC, totalizer, indicator |
| 3. Filter Backwash Water | 1 | • 1067/1067 mm dia. (I/O) short form Venturi tube<br>• 34,100 to 341,000 $m^3/d$ | • Filter Pipe Gallery, common wash water pump discharge header | • local: DP totalizing indicating transmitter, signal to PC, ACP and PBWCC<br>• remote: totalizing indicator on PBWCC, summating by PC |
| 4. Surface Wash Water | 1 | • 203/203 mm dia. (I/O) short form Venturi tube<br>• 9.1 to 91 L/s | • Chemical Building S4 off District 2E discharge main | • local: DP totalizing indicating transmitter, signal to PC and SCP<br>• remote: totalizer, indicator |
| 5. Plant Service Water | 1 | • 406/406 mm dia. (I/O) short form Venturi tube<br>• 37.9 to 379 L/s | • Chemical Building S4 off district 1E discharge main | • local: DP totalizing indicating transmitter, signal to PC and SCP<br>• remote: totalizer, indicator |
| 6. Total Filtered Water | 1 | • bonded strain gauge Ramapo-type flow meter<br>• 91,000 to 910,000 $m^3/d$ | • Treated Water Transfer Channel between Clear Well and Reservoir | • local: DP indicating transmitter, signal to PC and ACP<br>• remote: totalizer, indicator |
| 7. Plant Output<br>• District 1E | 1 | • 2286/2286 mm dia. (I/O) short form Venturi tube<br>• 113,600 to 1,136,000 $m^3/d$ | • Chemical Building S4 | • local: DP indicating transmitter, signal to PC and SCP and Revenue Meters<br>• remote: totalizer, indicator/recorder, PC used for calculating net district flow and total plant output |

TABLE B.1 - FLOW METERING EQUIPMENT (cont'd)



| SERVICE | NUMBER | TYPE & CAPACITY RANGE | LOCATION | INSTRUMENTATION |
|---|---|---|---|---|
| 7. Plant Output (cont'd)<br>• District 2F | 1 | • 1219/1372 mm dia. (I/O) short form venturi tube<br>• 31,800 to 318,000 $m^3/d$ | • Chemical Building S4 | • local: DP indicating transmitter, signal to PC, SCP and Revenue Meters<br>• remote: totalizer, indicator/recorder, PC used for calculating net district flow and total plant output |
| 8. Waste Water to Clarifiers | 2 | • bonded strain gauge Ramapo-type flow meter<br>• 3,200 to 32,000 $m^3/d$ | • Waste Water Clarifier Pipe Gallery, on inlet pipe to each Clarifier | • local: DP indicating transmitter, summator, signal to PC and Sludge Pumping Panel<br>• remote: totalizer, indicator, summation by PC |
| 9. Settled Sludge to Highland Creek S.T.P. | 1 | • 76/76 mm dia. (I/O) magnetic flow meter<br>• 1.9 to 19 L/s | • Waste Water Clarifier Pipe Gallery, on sludge pump discharge piping | • local: flow transmitter, indicator and totalizer, signal to PC |

Legend

Local: At Instrument and Nearby Control Panel
Remote: At Plant Analogue Contr~l Panel
DP = Differential Pressure, I/O = Inlet/Outlet
PC = Computer Process Controller
ACP = Analogue Control Panel
SCP = Supervisory Control Panel
PBWCC = Portable Backwash Control Console

Filter backwash water flow is measured by Venturi tube flow meter and used for control of the backwash rate. The flow signal is transmitted to the process controller and to the portable backwash control console. A totalizing indicator is mounted on the portable backwash control console. The flow rate is a manual input to the backwash program which is automatically executed by the process controller.

The flow to the filter surface wash equipment is monitored via a Venturi tube meter with remote totalizing indicator. Service water, for other in-plant water usage, is similarly monitored.

The treated water flows, or plant output, are measured in each of the two discharge mains to Districts 1E and 2E. Flow is monitored at the supervisory control panel with individual totalizer, indicator-recorders. The net district flow is calculated by the process controller for District 1E by subtracting the service water flow signal, and for District 2E by subtracting the surface wash water signal from respective plant output flow signals. The total plant output is also calculated by the process controller. This signal serves as the flow signal for quantitative pacing of sulphur dioxide and ammonia feed equipment. A further set of flow totalizer, indicator-recorders, one for each flow meter, is locally mounted in the Chemical Building S4. Recorders are 7-day circular chart instruments for increased accuracy in interpolating measured flow. These meters are known as the revenue meters and are used for billing purposes.

## B.2 ACCURACY OF FLOW MEASUREMENTS

Flow meter accuracy has been assured by the use of Venturi tube primary flow elements which have a specified accuracy of one-half of one per cent at mid-range of actual flow and one per cent at the extremeties of the flow range.

Transmitting instruments and totalizers are generally subject to additional error. Transmitters at the plant have a specified accuracy of one-half of one per cent of actual differential pressure. The specified accuracy for totalizers is one per cent.

Using the above specifications, the system accuracy can be estimated. Two methods are normally used for estimating system accuracy - the least and root-square accuracy. The former is very conservative and is based on the assumption that the inaccuracy of each component is additive. The latter is less conservative and is based on the assumption that it is not probable that all components will have the greatest static error at the same point at the same time. Thus the maximum error is derived from the square root of the sum of the squares of individual components inaccuracies.

Based on these established procedures, the estimated system accuracy for multiple meters with summated flow signals at the Easterly plant would be:

- least accuracy: ± 3.0%
- root square accuracy: ± 1.6%

It should be noted, however, that there is no proven basis for evaluating the accumulative effect of component accuracies, and only an actual system calibration can reliably establish the total inaccuracy.

In reviewing the plant flow data, it was observed that raw water flow in 1986 exceeded treated water flow (plant output) by the following:

- range: · 2.58 to 5.05%
- average: · 3.89%

In comparing 1986 raw water flow with total filtered water flow it will be evident that raw water flow exceeded total filtered water flow by the following amounts:

- range: · 0.49 to 1.43%
- average: · 0.22%

The net difference between filtered water flow and treated water flow, therefore, was 3.67% for 1986. This difference is accounted for by:

| | | | |
|---|---|---|---|
| - | filter backwash water: | 1.1 to 2.7% | range |
| | | 1.84% | average |
| - | filter surface wash: | 0.01% | average |
| - | plant service water: | 0.8%± | |
| - | meter reading error: | 1.0%± | |

The above breakdown indicates that the average amount of water used for filter cleaning and in-plant use, amounting to 2.65% of the total filtered water, accounts for most of the difference in the filtered water and treated water flow readings.

The above analysis leads to the conclusion that plant flow meters are relatively accurate. Instruments are calibrated monthly under the preventative maintenance schedule, and more frequently if required.

# SECTION C

# PROCESS COMPONENTS

# SECTION C - PROCESS COMPONENTS

## C.1 GENERAL

The Metropolitan Toronto Easterly Filtration Plant, constructed from 1974 to 1979, was designed for a capacity of 454,600 $m^3/d$ with a 50% overload capability for 681,900 $m^3/d$. Provisions were made for a two-stage expansion to increase the ultimate capacity of the plant to 1,363,800 $m^3/d$ design flow and 2,045,700 $m^3/d$ maximum hydraulic flow.

The Block Flow Diagram in Figure C.1 illustrates the treatment facilities that are provided.

The plant design utilizes the principle of direct filtration for treatment. This process essentially is similar to conventional treatment with the exception of the sedimentation process which is not included. Treatment for particulate removal, therefore, is achieved by coagulation, flocculation and dual media, high rate filtration. At the Easterly plant, pretreatment (before filtration) is divided into four process streams consisting of modules 1 and 2 and modules 3 and 4. Each of the four pretreatment units include in-line mechanical blenders for chemical coagulation of the raw water. The flocculation process, following flash mixing, consists of innovative in-line pipe flocculation for modules 1 and 2 and three-stage constant rate or tapered mechanical flocculation for modules 3 and 4. Each module was designed for twenty-five percent of the design flow or 113,650 $m^3/d$.

Raw water screens were not provided but the plant layout provides space for the addition of screens between the raw water pumps and the in-line blenders should they be required in the future.

The filter building has 8 filters, 4 on each side of a central filter and pipe gallery. Individual filters are divided into 2 cells by a central wash water gullet. Filtered water collects in a bull-head flume and discharges to a central filtered water conduit and two-celled clear well below the filters. The clear well overflows at high level and conveys water to the treated water reservoir which provides storage

capacity for 1) the filter backwash pumps, and 2) balancing of raw and treated water pumping rates.

Raw water pumps, with a firm station capacity of 772,800 $m^3/d$, pump the water from the inlet well of the 30 metre diameter buried Raw Water Pumping Station and discharge through two 900 mm dia. and four 1050 mm dia. vertical risers from the pumps to a common 1800 mm dia. ring header. From the ring header two 1370 mm dia. supply pipes convey water to the four 900 mm dia. pretreatment pipelines - modules 1 to 4.

Following the reservoir water flows through the chemical mixing channel and treated water suction channel to the Treated Water Pumping Station. Treated water pumping equipment is available to serve Pressure District 1E and Pressure District 2E of the distribution system. The firm station capacity is 545,600 $m^3/d$ and 54,500 $m^3/d$ for the two respective districts.

Chemical treatment is provided in the form of:

- prechlorination of the raw water
- alum coagulation to aid clarification and filtration
- postchlorination for disinfection
- superchlorination for the control of above normal levels of bacteria as well as any taste and odour
- dechlorination using sulphur dioxide to reduce residual chlorine levels
- fluoridation for the control of dental caries
- ammoniation to maintain a long-lasting residual in the distribution system.

The filter backwash waste water is stored in two surge tanks below the filters and is treated on a continuous basis in two circular solids-contact clarifiers. The settled sludge is pumped to the Highland Creek Pollution Control Plant for further treatment and disposal while the clarified overflow is discharged to a natural watercourse in the nearby planned East Point Park.

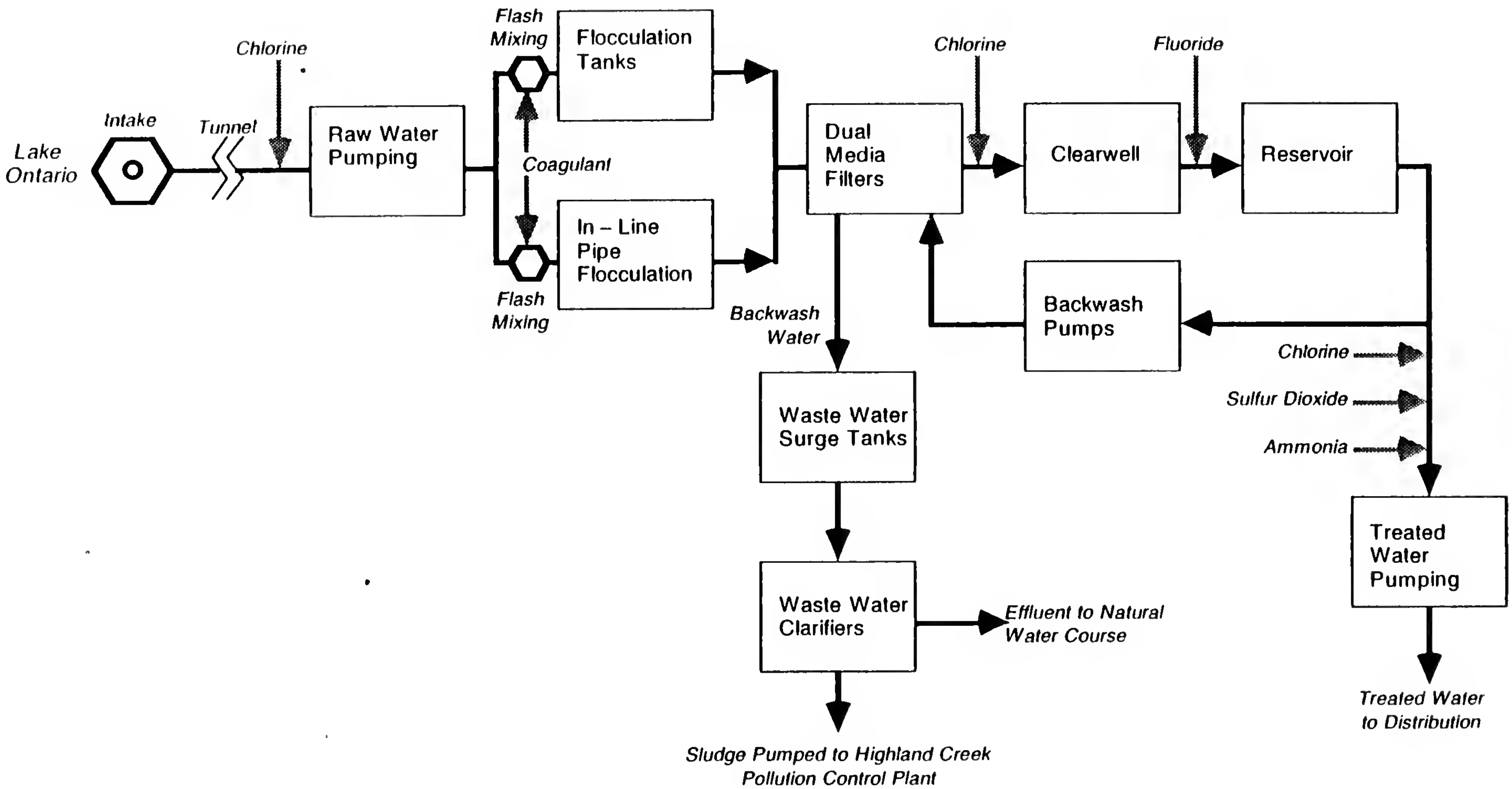


Figure C.1
METROPOLITAN TORONTO
EASTERLY FILTRATION PLANT
**Block Flow Diagram**

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## C.2 DESIGN DATA

A summary of the design data and relevant plant information is presented in Table C.1. The Process Design Schematic in Figure C.2 illustrates the relationship of process components and provides a convenient overview of the sizing and capacities of these components.

### a) Capacity

The plant was designed for an initial capacity of 454,600 $m^3/d$. It is based on a modular layout suitable for a 2-stage expansion for an ultimate capacity of 1,363,800 $m^3/d$. All units are sized for a 50% overload capability. The existing maximum hydraulic capacity, therefore, is 681,900 $m^3/d$ while the ultimate hydraulic capacity will be 2,045,700 $m^3/d$.

### b) Capacity Limitations

The design capacity of 454,600 $m^3/d$ for the existing plant is not limited by any equipment or process units. During the summer peak demand period the presence of algae in the raw water reduce filter runs but have no adverse impact on the operation of the dual media filters.

## C.3 PROCESS COMPONENT INVENTORY

### a) Intake

The intake consists of a 3,350 mm dia. by 3,210 m long concrete lined tunnel constructed in rock about 30 m below the lake bed.

The steel intake crib consists of a bell mouth which is protected by a fibreglass bar screen with 150 mm openings. It is located 2,960 m offshore in 18 m of water at average lake level. The minimum submergence of the bell mouth is 10.6 m at a minimum lake level of 73.6 m.

The intake has a capacity of 24.22 $m^3/s$ (2,092,600 $m^3/d$) at a maximum draw-down of 4.27 m. The volume of the intake is about 29,600 $m^3$.

A two-celled surge well on the intake, located on the inlet well of the Raw Water Pumping Station, has a combined volume of about 338 $m^3$.

No problems have been experienced with the operation of the intake.

b) Raw Water Screens

Provision has been made for the future installation of raw water screens if required.

c) Raw Water Pumping

The 30.48 m dia. Raw Water Pumping Station includes six pumps and has space for six additional pumps. Pumps are of the horizontal, double suction, centrifugal type with bottom suction and side discharge ports. Suction is taken from the 9.1 m. dia. inlet well located in the centre of the station.

The capacity of the raw water pumps is given in Table C.2.

Pump controls are available for remote manual start/stop from the process controller in the control room or locally from the control panel at the high voltage distribution panel. A lockout stop push-button is provided at the motor.

Pumps are arranged for "auto-stop-check" control by starting-up and shutting-down against motorized butterfly valves on their respective discharge headers. Motorized valves can also be used for trim throttling of pumps during start-up to reduce the incremental flow increase and minimize possible upset to filters.

The installed low lift station capacity is 954,700 $m^3$/d. With the largest pump out-of-service, the firm pumping capacity is 772,800 $m^3$/d. In case of a power failure all pumps shut down. Standby power generation capacity is only available for maintaining electrical controls and essential services such as sump pumps and lighting.

TABLE C.1

METROPOLITAN TORONTO EASTERLY FILTRATION PLANT

DESIGN DATA AND PLANT INFORMATION

| | |
|---|---|
| **PLANT ADDRESS** | |
| Municipality | Metropolitan Toronto |
| Plant Name | Easterly Filtration Plant |
| Plant Address | 201 Copperfield Rd., West Hill, Ont. |
| Phone Number | (416) 392-2572(3)(4) |
| **YEAR PLANT OPENED** | 1979 (built from 1974 to 1979) |
| **WATER SOURCE** | Lake Ontario |
| **PLANT CAPACITY** | |
| Design Capacity | 454,600 $m^3/d$ |
| Max. 1987 Flow | 545,000 $m^3/d$ |
| Ultimate Capacity | 1,363,800 $m^3/d$ |
| Ultimate Hydraulic Flow | 2,045,700 $m^3/d$ |
| **INTAKE** | |
| Crib | - fabricated steel, bell mouth intake crib protected by fibreglass bar screen with 150 mm openings, crib elev. 63.033 m<br>- 10.6 m minimum submergence, based on low lake level of 73.59 m |
| Tunnel | - 3353 mm I.D. by 3210 m long (2,960 m offshore), concrete lined in rock 30 m (avr.) below lake bed |

## INTAKE (Continued)

| | |
|---|---|
| • Capacity | - 24.22 $m^3/s$ @ 4.27 m drawdown (2,092,600 $m^3/d$)<br>- volume of intake is about 29,600 $m^3$ |
| Surge Well | - 2 wells triangular in shape, 76.6 $m^3$ and 261.5 $m^3$ |

## RAW WATER PUMPING STATION

| | |
|---|---|
| Raw Water Screens | - none provided |
| Pumps | - 6 installed, 6 future, horizontal, double suction, centrifugal, electric induction motors |
| • Capacity | - 4 @ 2105 L/s @ 45.7 m TDH; motor rating - 1119 kW<br>- 2 @ 1315 L/s @ 45.7 m TDH; motor rating - 746 kW<br>- 954,700 $m^3/d$ installed; 772,800 $m^3/d$ firm |
| • Discharge Piping | - 4 @ 760 mm dia. increasing to 1060 mm dia. riser<br>- 2 @ 600 mm dia. increasing to 900 mm dia. riser<br>- riser pipes discharge into 1830 mm dia. ring header that terminates into 2-1370 mm dia. risers, these branch into 4-900 mm dia. raw water distribution pipes which convey water to each of the 4 Pretreatment Modules |

## FLASH MIXING

| | |
|---|---|
| In-Line Blenders | - 4 @ 900 mm dia. each |
| • Capacity Range | - 90,920-170,475 $m^3/d$, 113,650 $m^3/d$ design |
| • Detention Time | - 0.2 s design, 0.25-0.13 s range |
| • Motor Size | - 2.24 kW |
| • G Value | - 1000 $s^{-1}$ |
| • Gt Product | - 200 design, 250-130 range |
| • Impeller | - 2 radial flow propellers in parallel, st. st. shaft and blades |

## FLOCCULATION

| | |
|---|---|
| Type | - Modules #1 and #2 - In-Line Pipe Flocculation, Modules #3 and #4 - Mechanical, 3-stage, Tapered Flocculation |
| Mechanical Flocculation | - 2 concrete tanks with 3 cells per tank |
| • Tank Size | - 11.77 m W x 35.43 m L x 6.39 m D, 5.59 m SWD |
| • Cell Size | - 11.77 m W x 11.58 m L x 6.39 m D |
| • Inlet Channel | - 1 per tank, 1.98 m W x 11.77 m L x 6.39 m D with 5 inlet ports each, open area 4.19 $m^2$, 4 gates per tank on outlet with 5.95 $m^2$ total area |
| • Capacity Range | - 90,920-170,475 $m^3/d$, 113,650 $m^3/d$ design |
| • Detention Time | - 10 min. per cell, 30 min. total design, 37.5-20 min. range per tank |
| • Flocculator | - axial flow turbine mixer, 56 rpm variable speed, st. st. impeller 1 per cell, 6 total, |
| - Motor Rating | - 7.46 kW |
| - G Value | - 20 to 60 $s^{-1}$ capability, operating at 20 $s^{-1}$ (25 rpm) each |
| - Gt Product | - variable, 36,000 with present G value at design flow |
| - Flocculated Water Conduit | - 3.05 m W x 70.56 m L x 2.74 m D (to West Pre-Filtered Water Conduit) |
| In-Line Flocculation | - mixing achieved by form losses and pipe friction, 2 modules, 900 mm dia. steel pipe |
| • Length to East Pre-Filtered Water Conduit | - Module 1 - 92.26 m, Module 2 - 95.25 m, connections to West Pre-Filtered Water Conduit for standby only |
| • Volume (to East PFWC) | - Module 1 - 61.17 $m^3$, Module 2 - 63.01 $m^3$ |
| • Design Capacity | - 90,920-170,475 $m^3/d$, 113,650 $m^3/d$ design |
| • Detention Time (to East PFWC) | - Module 1 - 46.5 s, Module 2 - 47.9 s (@ design flow) |
| • G Value | - 209 $s^{-1}$ @ design flow, range 150 to 350 $s^{-1}$ |
| • Gt Product | - 9,700 to 10,000 @ design flow, range 8,700 to 11,100 |

## FILTRATION

| | |
|---|---|
| Number | - 8 filters each divided into 2 cells by central wash water gullet, filters arranged in two banks of 4 with central pipe and operating galleries |
| Pre-Filtered Water Conduit | - 3.05 m W x 3.71 m D x 58.7 m L East and West Conduits and 40.8 m L South Conduit |
| Filter Type | - dual media, rapid sand filters |
| Size | - 6.10 m W x 16.76 m L per cell, 13.92 m W x 16.76 m L overall, the filter box is 5.18 m D |
| Surface Area | - 102 $m^2$ per cell, 1632 $m^2$ total |
| Filter Rate | - 11.7 m/h design, 23.4 m/h max. hydraulic |
| Media | - 460 mm anthracite, E.S. = 1.20 mm, U.C. = 1.35 |
| | - 300 mm sand, E.S. = 0.44 mm, U.C. = 1.35 |
| | - 300 mm graded gravel, 4 layers - 19 to 1.2 mm dia. |
| Underdrains | - Leopold, dual parallel lateral type, 250 mm D x 280 mm W each |
| Surface Wash | - Palmer, rotary surface agitators, 5.33 m dia., 3 per cell |
| Wash Water Rate | - 55 m/h max. rise rate for 3 pumps |
| Filtered Water Conduit | - 6.10 m W x 2.63 m D, conveying filtered water to Clear Well 1 and 2 |

## CLEAR WELL

| | |
|---|---|
| Size | - 2 wells, each 23.3 m W x 91.3 m L x 6.0 m D, 5.68 m SWD (fixed storage) |
| Volume | - 12,000 $m^3$ per cell, 24,000 $m^3$ total |
| Detention Time | - 1.27 h @ design flow |

## RESERVOIR

| | |
|---|---|
| Size | - 102.8 m W x 144.3 m L x 5.4 m D,1 4.72 m SWD max. |
| Volume | - 70,000 $m^3$ (including Chemical Mixing and Treated Water Suction Channels) |

TABLE C.1 - DESIGN DATA AND INFORMATION (cont'd) 

## TREATED WATER PUMPING STATION

| | |
|---|---|
| Treated Water Pumps | |
| • Type | - horizontal, centrifugal, double suction; electric induction motor |
| • District 1E | - 4 @ 2105 L/s @ 57.3 m TDH, motor rating - 1567 kW |
| • District 2E | - 1 @ 1315 L/s @ 91.4 m TDH, motor rating - 1492 kW |
| | - 1 @ 631 L/s @ 91.4 m TDH, motor rating - 634 kW |
| • Station Capacity | - 6315 L/s firm District 1E, 631 L/s firm District 2E |
| Backwash Pumps | |
| • Type | - vertical turbine, centrifugal; electric induction motor |
| • Number/Capacity | - 4 @ 1052.3 L/s @ 22.6 m TDH, motor rating - 298.4 kW |
| Hydropneumatic Tanks | - District 1E - 2-3.96 m dia. x 17.8 m L, District 2E - 1-3.96 m dia. x 7.6 m L |

## WASTE WATER SURGE TANKS

| | |
|---|---|
| Size | - 2 - 19.96 m W x 23.66 m L x 6.53 m avg. D, total volume 6,168 $m^3$ |
| Mixing | - 3 air blowers, 472 $dm^3/s$ each @ 48.3 kPa, motor rating 56 kW, 4 air spargers per tank, 75 mm dia. pipe header x 1.5 m square loop |
| Waste Water Pumps | - 3 - 105.23 L/s @ 12.2 m TDH, 18.6 kW, non-clog, horizontal centrifugal |

## WASTE WATER CLARIFIERS

| | |
|---|---|
| Size | - 2 circular, solids-contact clarifiers with internal sludge recirculation, 30.5 m dia. x 5.4 m H, 4.88 m SWD |
| Capacity | - 9,090 $m^3/d$ design, 27,270 $m^3/d$ max. |
| Loading Rate | - 0.63 m/h design, 1.89 m/h max. rate |
| Detention Time | - 8 h @ design flow |

## WASTE WATER CLARIFIERS (Continued)

| | |
|---|---|
| Recirculation Rate | - 526 L/s design, 1578 L/s max. |
| Flocculator | - 18.7 kW turbine mixer, 0.5 h detention time in floc zone @ design flow |
| Sludge Collector | - structural steel collector mechanism with 3.73 kW motor |

## SLUDGE TRANSFER PUMPS

| | |
|---|---|
| Type | - submersible, non-clog sludge pump |
| Capacity | - 2 - 20 L/s @ 9.1 m TDH, 3.7 kW motor (1 duty, 1 standby, 1 future) |

## CHEMICAL PROCESSES

| | |
|---|---|
| Chlorination | - gaseous chlorine applied in solution form |
| • Prechlorination | - applied in Raw Water Inlet Well |
| • Postchlorination | - applied at outlet of Filtered Water Conduit |
| • Trim chlorination | - applied in Chemical Mixing Channel (immediately downstream of Reservoir), if required |
| • Storage | - 34-910 kg containers |
| • Scale | - 6-2 container weigh scales, 2 for each service, digital indicator and transmitter |
| • Evaporators | - 6 evaporators (2 per service), 3640 kg/d each |
| • Feeders | - 6 chlorinators (2 per service), 3640 kg/d capacity, rotameter ratings are: 1960 kg/d pre-, 2270 kg/d post-, and 910 kg/d trim-chlorinator, injectors are located at application points |
| Dechlorination | |
| • Chemical Applied | - gaseous sulphur dioxide in solution form<br>- applied in Chemical Mixing Channel at outlet of Reservoir |

| | |
|---|---|
| **Dechlorination (continued)** | |
| • Storage | - 16 - 910 kg containers |
| • Scale | - 2-2 container weigh scales with digital indicators and transmitters |
| • Evaporators | - 3-3640 kg/d evaporators |
| • Feeders | - 3-3450 kg/d sulphonators with 1 @ 1720 kg/d and 2 @ 900 kg/d plug positioners, injectors are located close to application point |
| **Emergency Chlorine Scrubber** | |
| • Chemical Applied | - caustic soda solution, 20% by wt.<br>- applied to air scrubber in chlorine room during chlorine gas leak |
| • Storage | - 2-11,400 L F.R.P. bulk storage tanks |
| • Recirculation Pumps | - 2 @ 12.6 L/s each @ 15 m TH (approx.), 2.24 kW motor,<br>- pumps are end-suction centrifugal pumps by Smart Turner |
| **Fluoridation** | |
| • Chemical Applied | - hydrofluosilicic acid is applied in the Treated Water Transfer Channel (at inlet to Reservoir) |
| • Storage | - 2-40,900 L bulk storage tanks, concrete/F.R.P. liner construction |
| • Metering | - pneumatic ejector system transfers bulk acid to 3 - 680 L day tanks mounted on weigh scales<br>- scales include digital read-out cabinets and loss-of-weight transmitters<br>- 3-227.3 L/h @ 56.3 m TH, metering pumps, feed range: 5.90 - 145.5 L/h, motor: 0.44 kW DC |
| **Ammoniation** | |
| • Chemical Applied | - aqua ammonia applied in Chemical Mixing Channel |
| • Storage | - 2-27,000 L bulk storage tanks, 1 future, mild steel construction, 3.05 m dia. x 3.73 m H<br>- 2-0.303 L/s @ 21 m TH transfer pumps, motor rating 0.44 kW |
| • Metering | - 2-77.28 L/h @ 56.3 m TH metering pumps, motor rating 0.29 kW DC, feed range: 2.73-50.0 L/h<br>- 2-680 L day tanks mounted on weigh scales, scales include digital read-out cabinets and loss-of-weight transmitters |

## CHEMICAL PROCESSES (Continued)

| | |
|---|---|
| Coagulation | |
| • Liquid Alum | - bulk storage in 2 concrete tanks, 158.9 $m^3$ each, 1 tank provided for future use |
| • Metering | - 5 diaphragm chemical metering pumps (4 duty, 1 standby), capacity: 0-409 L/h @ 552 kPa,<br>- applied at in-line blenders |
| Alternate Coagulant | |
| • Poly Aluminum Chloride | - bulk storage in 2-27,000 L F.R.P. tanks (originally served as cationic and anionic polymer solution tanks) |
| • Metering | - 4 metering pumps, 77 L/h @ 550 kPa, applied at in-line blenders |
| Waste Water Treatment | |
| • Chemical Applied | - Anionic polyelectrolyte settling aid |
| • Storage | - 1-27,000 L neat polymer tank, 3.05 m dia. x 4.27 m H<br>- 1-900 L tank for activator solution<br>- 1-9,000 L mix tank for make-up of 1.5% polymer solution<br>- 1-27,000 L polymer solution tank<br>- all tanks are of F.R.P. construction |
| • Pumps | - 1-diaphragm neat polymer transfer pump, 1450 L/h @ 550 kPa<br>- 1-diaphragm activator transfer pump, 77 L/h @ 550 kPa<br>- 1-progressive cavity polymer solution transfer pump, 590 L/min. @ 280 kPa<br>- 2-diaphragm chemical metering pumps, 410 L/h @ 550 kPa, 1 duty, 1 standby, 10:1 in-line dilution downstream of metering pump |
| • Application Point | - in-line blender, before or after impeller, in waste water header to clarifiers |
| Coagulant Aid or Filter Aid | |
| • Chemical Applied | - cationic polymer, low molecular weight (or high molecular weight nonionic polymer) |

| | |
|---|---|
| Coagulant Aid or Filter Aid (cont'd) | |
| • Storage | - 1-27,000 L bulk storage of neat polymer, 3.05 m dia. x 4.27 m H<br>- 1-900 L tank for activator solution<br>- 1-9,000 L mixing and aging tank, for 15% cationic polymer solution or 1.5 % nonionic polymer solution<br>- 1-27,000 L polymer solution tank<br>- all tanks are F.R.P. construction |
| • Pumps | - 1-diaphragm neat polymer transfer pump, 1450 L/h @ 550 kPa<br>- 1-diaphragm activator transfer pump, 77 L/h @ 550 kPa<br>- 1-polymer solution progressive cavity transfer pump, 590 L/min @ 270 kPa<br>- 4-diaphragm chemical metering pumps, 77 L/h @ 550 kPa<br>- 10:1 in-line dilution provided after pumps |
| • Application Points | - as Coagulant Aid: at in-line blenders, before or after impellers<br>- as Filter Aid: at Pre-Filtered Water Conduits |
| Filter Pre-Conditioning | |
| • Chemical Applied | - nonionic polymer (or high molecular weight cationic polymer) |
| • Storage | - 1-1,140 L F.R.P. neat polymer tank, 0.91 m dia. x 3.05 m H<br>- 1-90 L P.E. tank for activator solution<br>- 1-270 L P.E. polymer mixing and aging tank<br>- 1-2,280 L F.R.P. solution storage tank |
| • Pumps | - 1-diaphragm neat polymer transfer pump,, 77 L/h @ 550 kPa<br>- 1-diaphragm activator transfer pump, 4.5 L/h @ 550 kPa<br>- transfer of polymer solution by gravity through a powered valve<br>- 2-diaphragm chemical metering pumps, 1500 L/h @ 550 kPa<br>- 10:1 in-line dilution water added downstream of pumps |
| • Application Point | - filter backwash header in front of each filter |

CHEMICAL PROCESSES (Continued)

On-Line Monitors

| | |
|---|---|
| • pH Analyzer | - 1 pH analyzer indicting transmitter on raw water, located in Raw Water Pumping Station (R.W.P.S.), range 4 to 10 pH units, 4-20 mA DC signal transmitted to Process Controller (P.C.) |
| • Temperature | - 1 temperature analyzer indicating transmitter on raw water, located in R.W.P.S., range -5 to 40°C, 4-20 mA DC signal transmitted to P.C. and indicator on Analog Control Panel (A.C.P.) |
| • Turbidity | - continuous reading, high range, turbidimeters provided on: raw water (by Hach Model Surface Scatter), backwash water, and waste water service (by Lyle Metrix)<br>- continuous reading, low range, Nephelometric type, turbidimeters provided on: filter effluent and interface, and plant output service (by Hach Model 1720A)<br>- meters include local indication, 4-20 mA DC signal transmission to P.C., A.C.P., and Mobile Filter Control Console in case of backwash water service |
| • Chlorine Residual | - 7 chlorine residual analyzer indicating transmitters are provided for monitoring and for control of chlorine dosage setpoints as follows:<br>AIT-Cl 1: raw water, 0-1.0 mg/L range total, monitoring and control located on ring header floor in Raw Water Pumping Station<br>AIT-Cl 2: composite filter effluent, 0-1.0 mg/L range total, monitoring, located in Filter Pipe Gallery<br>AIT-Cl 3: filtered water after postchlorination, 0-5.0 mg/L range free, (composite of two clear wells), monitoring and control, located in Filter Pipe Gallery |

On-Line Monitors (cont'd)

- Chlorine Residual
  - AIT-Cl 4: filtered water 30 minutes after postchlorination, 0-5.0 mg/L range free, monitoring and control, located in Filter Pipe Gallery
  - AIT-Cl 5: Reservoir outlet before dechlorination, 0-5.0 mg/L range free, monitoring, located in Treated Water Reservoir Gallery
  - AIT-Cl 6: Reservoir outlet after dechlorination (but before ammoniation), 0-2.0 mg/L range free, monitoring and control, located in Treated Water Reservoir Gallery
  - AIT-Cl 7: Plant output, 0-2.0 mg/L range total, monitoring, located in Treated Water Reservoir Gallery
  - all analyzers transmit 4-20 mA DC signals to the P.C. and A.C.P.
- Fluoride
  - 1 Anafluor analyzer indicating transmitter was provided for monitoring the fluoride residual in the treated water, 0.2-2.0 mg/L range, 4-20 mA DC signal transmission to P.C. and A.C.P., located in Treated Water Reservoir Gallery
  - note: this instrument is not used due to malfunctioning

## TABLE C.2

## RAW WATER PUMPS

| Pump No. | Rated Capacity Flow L/s | Head m | Type | Motor Rating kW | Manufacturer Pump Motor |
|---|---|---|---|---|---|
| 22 & 23 | 1315 | 45.7 | centrifugal | 746 | Ebara<br>Yaskawa Electric |
| 18, 19, 26 & 27 | 2105 | 45.7 | centrifugal | 1119 | Ebara<br>Yaskawa Electric |
| 17, 20, 21, 24, 25 & 28 future | | | | | |

Notes:

Installed Capacity: 954,700 $m^3/d$
Firm Capacity: 772,800 $m^3/d$

TABLE C.3

FLASH MIXING PROCESS DESIGN

| Plant Flow, $m^3/d$ | Detention Time, s | G Value, $s^{-1}$ | Gt Product |
|---|---|---|---|
| 90,920 - minimum | 0.25 | 1000 | 250 |
| 113,650 - design | 0.2 | 1000 | 200 |
| 170,475 - maximum | 0.13 | 1000 | 130 |

TABLE C.4

FLOCCULATION PROCESS DESIGN

## A. FLOCCULATOR SPECIFICATION

| Unit | Flocculator | Motor Rating, kW | Impeller Diameter, m | Impeller Speed, rpm | G Value $s^{-1}$ |
|---|---|---|---|---|---|
| Mechanical Flocculators | | | | | |
| Tanks 1 & 2 - all cells | 6-turbine mixers | 7.46 | 1.47 | 57 | |
| Velocity Gradient | | | | | |
| · Range | | | | | 20 to 60 |
| · Average - design | | | | | 35 |
| - actual | | | | | 20 each cell |
| In-Line Pipe Flocculators | | | | | |
| Modules 3 & 4 | mixing by turbulent flow | | | | |
| Velocity Gradient at: | | | | | |
| · 90,920 $m^3/d$ - min. | | | | | 150 |
| · 113,650 $m^3/d$ - design | | | | | 209 |
| · 170,475 $m^3/d$ - max. | | | | | 350 |

## B. PROCESS DESIGN

| | Mechanical Flocculators | In-Line Flocculators Module 1 | In-Line Flocculators Module 2 |
|---|---|---|---|
| Detention Time at: | | | |
| · 90,920 $m^3/d$ - minimum | 37.5 min. | 58.1 s | 59.9 s |
| · 113,650 $m^3/d$ - design | 30 min. | 46.5 s | 47.9 s |
| · 170,475 $m^3/d$ - maximum | 20 min. | 31.0 s | 31.9 s |
| Gt Product for G of 35 $s^{-1}$ at: | | | |
| · 90,920 $m^3/d$ - minimum | 78,750 | 8,700 | 9,000 |
| · 113,650 $m^3/d$ - design | 63,000 | 9,700 | 10,000 |
| · 170,475 $m^3/d$ - maximum | 42,000 | 10,850 | 11,200 |

d) Flash Mixing

Each of the four pretreatment modules is equipped with one in-line mechanical blender. They are installed in 900 mm dia. pipes and have a flow range of 90,920 to 170,475 $m^3/d$ each; the design flow being 113,650 $m^3/d$.

In-line blenders were designed to produce high velocity gradients to achieve near instantaneous mixing of coagulant and polyelectrolyte chemicals. Mixing is achieved by two opposed flow impellers mounted on a single shaft and driven by a motor of 2.24 kW capacity. Alum coagulant solution is injected through a chemical proportioning system consisting of a feed manifold with six injection tubes. The alternate polyaluminum chloride coagulant is injected via a single port upstream of the blender.

Process design parameters vary with plant flow as is illustrated in Table C.3 following. In practice, minimum and maximum design flow rates are achieved by selecting the required number of pretreatment modules for operation.

In-line blenders for modules 1 and 2 are located immediately ahead of the flocculation tanks. Flow enters the flocculation tanks at the bottom through an inlet distribution channel measuring 1.98 m wide by 11.77 m long (per tank) by 6.39 m deep. Each channel has five inlet ports located along the floor of the channel for flow distribution. The total open area of these ports is 4.19 $m^2$ per channel.

The blenders for modules 3 and 4 are essentially a part of the in-line pipe flocculators and are located before the 180 degree vertical pipe bends.

e) Flocculation

Pretreatment modules 3 and 4 consist of two flocculation tanks which are divided into primary, secondary and tertiary cells for three-stage mechanical flocculation. Turbine flocculators are equipped with speed reducers to permit the use of tapered flocculation.

All cells are of equal size measuring 11.77 m wide by 11.58 m long by 6.39 m deep. The side water depth (SWD) at the design flow rate is 5.59 m and the tank volume is 2285.7 $m^3$ (761.9 $m^3$ per cell).

Each cell is equipped with a vertical turbine, axial-flow mixer designed to provide the more intense agitation consistent with the direct filtration process and to prevent deposition of floc in the cell. Each flocculator motor is rated at 7.46 kW and equipped with a speed reducer to provide a velocity gradient range of 20 to 60 $s^{-1}$. Initial design settings for tapered flocculation were 50, 35 and 20 $s^{-1}$ in each of the three respective cells. Currently, all flocculators are operated at the same speed for an equal energy input to each cell which is equivalent to a velocity gradient of 20 $s^{-1}$. The overall detention time varies with flow and ranges from 20 to 37.5 minutes for minimum and maximum design flows. At the design flow rate the detention time is 30 minutes and the equivalent Gt product, for an average G value of 35 $s^{-1}$, is 63,000. A complete summary of flocculator specifications and design parameters is given in Table C.4.

The flocculation tank inlet port velocities are:

| Plant Flow, $m^3/d$ | Inlet Velocity, m/s |
|---|---|
| 90,920 - minimum | 0.25 |
| 113,650 - design | 0.31 |
| 170,475 - maximum | 0.47 |

The tank outlet consists of four square ports, 1.22 m wide by 1.22 m high, equipped with sluice gates for positive shut-off. At the design flow the outlet velocity is 0.22 m/s or about 40 percent less than the flocculation tank inlet velocity. Flocculated water discharges to the flocculated water conduit with dimensions of 3.05 m wide by 70.56 m long by 2.74 m deep which conveys the flow to the prefiltered water conduit 1 (west side of filters).

For the in-line pipe flocculation, pretreatment modules 1 and 2, turbulent flow in the 900 mm diameter pipes provides the mixing function as

a result of hydraulic form losses and pipe friction. Physical characteristics of the flocculators are as follows:

| | Module 1 | Module 2 |
|---|---|---|
| Diameter, mm | 900 | 900 |
| Length, m (from blenders to prefiltered water conduit 2 - east side of filters) | 92.26 | 95.25 |
| Volume, $m^3$ | 61.17 | 63.01 |

A connection between each module and prefiltered water conduit 1 has been provided for use in an emergency situation.

At the design flow rate (113,650 $m^3/d$) the calculated process design parameters are:

- G value, $s^{-1}$ - 209
- Gt product
  - Module 1 - 9,700
  - Module 2 - 10,000

Since the detention times are low, the resultant Gt product values are also low. Both the detention time and velocity gradient, G, will vary with flow as is illustrated in Table C.4 by the values shown for the minimum and maximum design flow rates. The Gt product, however, remains relatively constant.

In the event that mixing is inadequate for good floc formation, provisions were made for the future installation of in-line static mixers with in-line pumps to overcome the additional head losses of the mixers.

f) Filters

The plant has eight dual media, gravity filters. They are arranged in two rows of four filters with central pipe and filter operating galleries. Filters operate on the principle of constant rate filtration. The capability also exists to operate filters in the declining rate mode. The design filtration rate is 11.7 m/h and the overload capacity is 23.4 m/h or two times the design rate.

Filters are divided into two compartments by a central wash water gullet and bull-head flume below. This results in long and narrow filter compartments measuring 6.10 m wide by 16.76 m long. Overall surface dimensions of one filter are 13.92 m wide by 16.76 m long. The filter box is 5.18 m deep. The wash water trough weir elevation is 3.05 m above the floor of the box.

Each filter has a surface area of 204 $m^2$ and the total area for eight filters is 1632 $m^2$.

Underdrains consist of the dual, parallel lateral block by Leopold measuring 250 mm deep by 280 mm wide. Underdrains are covered with four layers of graded gravel ranging in size from 19 mm to 1.2 mm with a total depth of 300 mm. The filter media has the following characteristics.

| Media | Depth | E.S., mm | U.C. |
|---|---|---|---|
| Anthracite | 460 | 1.20 | 1.35 |
| Sand | 300 | 0.44 | 1.35 |

Filter valves and piping include:

- 1370 mm dia. motorized butterfly inlet valve
- 1370 mm dia. motorized butterfly main drain valve
- 914 mm dia. effluent pipe with 914/760 mm (I/O) Venturi tube meter
- 760 mm dia. pneumatic butterfly rate control valve

- 1060 mm dia. backwash water pipe with motorized butterfly valve
- 200 mm dia. filter drain with manually operated gate valve.

Filters are equipped with six 5.33 m diameter rotary, straight arm, surface agitators. Backwash pumps are provided for a maximum wash water rise rate of 55 m/h with three pumps.

Wash Water System

Backwashing is accomplished with a direct pumped water backwash system consisting of four vertical turbine, centrifugal pumps driven by electric induction motors. Pumps are of Ebara manufacture and motors by Yasakawa Electric. Pumps have a capacity of 1052.3 L/s each at a total head of 22.6 m. The motor rating is 298.4 kW.

Filter Instrumentation

Filter instrumentation equipment includes the following:

- computer-based process controller (PC)
- portable backwash control console (PBWCC)
- filter box level gauge with signal transmission to PC and PBWCC
- prefiltered water conduit level gauge, transmitter, indicator
- master filter rate controller based on level in the prefiltered water conduit
- filter rate control valve with a) local/remote selector switch b) local manual loading station for valve control c) remote manual or auto control from process computer; remote manual or auto control from C-M-A controller in analogue control panel; manual open/close function from PBWCC for backwash
- Venturi tube flow meter with flow indicating transmitter to PC and PBWCC
- constant ramp generator for the control of the rate of opening of the filter rate control valve
- electric operators for motorized valves including the filter inlet valve, drain valve, backwash water valve and surface sweep valve, and pneumatic operators for filter rate control valves

- turbidity measurement of filter interface, two meters - one for each bank of filters
- turbidity measurement in filter effluent with signal transmission to process controller and analogue control panel, two meters - one for each bank of filters
- filter head loss measurement with indicating differential pressure transmitter for signal transmission to the process controller and analogue control panel
- multi-head loss measurement on filters 7 and 8 with locally mounted manometers and automatic selection of pressure tap for monitoring head loss distribution by process controller
- automatic filter backwash program resident in the process controller and the PBWCC and initiated on either filter head loss or effluent turbidity
- backwash water turbidity measurement for control of the duration of the high rate portion of the filter backwash (by PC or PBWCC), analyzer complete with indicating transmitter for signal transmission to the PC and PBWCC
- wash water flow measurement with indicating transmitter for signal transmission to the PC and PBWCC.

Clear Well

Flow from the filters discharges into a pressurized filtered water conduit (6.10 m wide by 2.63 m deep) which conveys filtered water to the clear well. The clear well consists of two cells measuring 23.3 m wide by 91.3 m long by 6.0 m deep. The sidewater depth is set by the effluent weirs at 5.68 m. The combined fixed storage capacity is 24,000 $m^3$ and the detention time is 1.27 h at the design flow rate. This capacity is sufficient to provide about 30 minutes retention time at the ultimate filter flow capacity of 909,200 $m^3/d$.

Clear well effluent discharges to the treated water transfer channel and thence to the treated water reservoir. The transfer channel measures 4.57 m wide by 6.10 m high and extends across the entire south side of the clear well and continues along the south and east walls of the reservoir.

Treated Water Reservoir

The treated water reservoir, with a capacity of 68,190 $m^3$ (about 70,000 $m^3$ with chemical mixing and treated water suction channels), was provided for the purpose of:

- providing balancing storage capacity for differences in raw and treated water pumping rates, and
- providing an emergency supply of treated water for short periods of pumping when production is shut down.

The reservoir has dimensions of 102.8 m wide by 144.3 m long by 5.4 m deep and the maximum side water depth is 4.72 m. A bypass channel at the north side of the reservoir is available for maintaining service while the reservoir is out of operation.

Chemical Mixing Channel and Treated Water Suction Channel

The discharge from the reservoir floods the wash water pump suction well and flows through the chemical mixing and treated water suction channels to supply water to the treated water pumps. These channels are 6.10 m wide by 9.75 m deep and 6.22 m wide by 9.75 m deep respectively and are designed to provide specific retention times for final chemical additions and residual monitoring.

Two mechanical mixers are provided in the chemical mixing channel - one at the beginning of the channel for dissolution of trim chlorine or sulphur dioxide, and one at the end for blending-in ammonia solution in the treated water.

In-Channel Mixers

The in-channel mixers, installed in the chemical mixing channel, are of the axial-flow turbine type and have the following performance characteristics:

| | |
|---|---|
| Design flow, nominal, $m^3/d$ | 227,300 |
| range, $m^3/d$ | 113,650 to 681,900 |
| Detention time per cell at | |
| nominal flow, s | 44.8 |
| range, s | 23 to 132 |
| Design water depth, m | 5.03 to 9.30 |
| Motor size, kW | 37.3 |
| Impeller shaft size, mm | 140 |
| Impeller speed, rpm | 25 |
| Impeller diameter, m | 3.048 |
| Pumping capacity, $m^3/d$ | 454,600 |

g) Treated Water Pumping

The pumping station has space for twelve treated water pumps - ten on District 1E and two on District 2E. Four pumps are installed on District 1E and two on District 2E. All pumps are of the horizontal, double suction, centrifugal type with bottom suction side discharge casings for District 1E pumps and bottom suction bottom discharge casings for District 2E pumps. Suction is taken from the treated water suction channel below the pump piping floor. Pump capacities and motor ratings are tabulated in Table C.5.

The installed treated water station capacity is as follows:

- District 1E: 727,500 $m^3/d$
- District 2E: 168,100 $m^3/d$.

With the largest pump out of service, the firm pumping capacity for each district is:

- District 1E: 623,400 $m^3/d$
- District 2E: 54,500 $m^3/d$.

No standby power is available to run these pumps during an emergency power outage.

Pumps are arranged for "auto-stop-check" control as for raw water pumps. District 1E pumps discharge into one 2280 mm diameter transmission main, while District 2E pumps discharge into one 1370 mm dia.

## TABLE C.5

## TREATED WATER PUMPS

| Pump No. | Rated Capacity Flow L/s | Head m | Type | Motor Rating kW | Manufacturer Pump Motor |
|---|---|---|---|---|---|
| District 1E: | | | | | |
| 2,3,5, 6 & 7 | Future | | | | |
| 8 & 9 | 2105 | 57.3 | centrifugal | 1567 | Ebara<br>Yaskawa Electric |
| 10 | Future | | | | |
| 11 & 12 | 2105 | 57.3 | centrifugal | 1567 | Ebara<br>Yaskawa Electric |
| District 2E: | | | | | |
| 1 | 631 | 91.4 | centrifugal | 634 | DeLaval<br>Cdn. General Electric |
| 4 | 1315 | 91.4 | centrifugal | 1492 | Mather & Platt<br>Westinghouse |

Notes:

Installed Capacity:

District 1E: 727,500 $m^3/d$

District 2E: 168,100 $m^3/d$

Firm Capacity:

District 1E: 623,400 $m^3/d$

District 2E: 54,500 $m^3/d$

transmission main. Plant output is metered in each of the two transmission mains by short form Venturi tube meters.

Control of the treated water pumps and their respective discharge valves normally is remote-manual from Central Pumping Control. Control from the plant in the remote-manual mode is available through a "local/remote" selector switch at the supervisory control panel. In the local mode pumps can be controlled manually through the process controller. Local start/stop controls have also been provided at the local pump control panel located in the high voltage electrical switchgear room. A lockout stop push-buttom is available at the motor. In an emergency situation when the water level in the treated water suction channel is very low, pumps will be tripped out automatically by a level indicating transmitter.

Information on pressures, and indirectly water levels, in the distribution system at the Ellesmere Reservoir and the Rouge Elevated Tank is available at the supervisory control panel at the plant via telemetering equipment.

Surge relief facilities on the treated water discharge mains are available in the form of hydropneumatic tanks. Two tanks measuring 3.96 m diameter by 17.8 m long are available on District 1E (2,280 mm dia. main) and one tank measuring 3.96 m diameter by 7.6 m long is available on District 2E (1,370 mm dial main). Air pressure in the tanks above the water surface is maintained automatically by air compressors.

h) Wash Water Treatment

Summary of System

Filter backwash water is the primary source of waste solids produced at the plant. A secondary potential source of solids is the underflow from the flocculation tanks which are cleaned on an annual basis. The drainage from the flocculation tanks is discharged to the wastewater surge tanks.

The treatment facilities provided consist of two wastewater surge tanks located below the filters at the north end of the Filter Building, two circular, solids-contact clarifiers with internal sludge recirculation, and associated mechanical equipment. The function of the surge tanks is to collect the filter backwash water on a high-rate batch basis and release them on a low-rate continuous basis to the solids-contact clarifiers for treatment. Solids are settled out in the clarifiers and discharged as a thickened sludge (in the order of 3 to 4% solids by weight) to the Highland Creek Pollution Control Plant for further treatment and disposal. The clarified overflow is discharged to the planned East Point Park natural drainage course.

## System Capacity

The wastewater treatment system has a design capacity of 18,200 $m^3/d$ with a 300 percent overload capacity (54,600 $m^3/d$). At the design rate the system is capable of handling backwash water quantities up to 4 percent of the design throughput capacity of the plant (454,600 $m^3/d$).

The actual quantities of backwash water generated amount to, on average, 1.8 percent of the water filtered. For an average yearly turbidity in the raw water of 1.65 FTU and an alum dosage of 3.5 mg/L, the average solids loading to the filters was about 2.2 mg/L. For an average filter run of about 30 hours, the average concentration of solids in the backwash water is about 115 mg/L.

## Wastewater Surge Tanks

Two surge tanks have been provided, one for each filter bank. Tank dimensions are 19.96 m wide by 23.66 m long by 6.53 m average depth. The combined storage volume is 6,168 $m^3$. Solids are kept in suspension by an air mixing system consisting of four air spargers per tank and 3 air blowers, 2 duty and 1 standby, rated at 472 $dm^3/s$ each at 48.3 kPa. The air blowers have a motor rating of 56 kW.

Wastewater is transferred to the clarifiers by 3 - 105.2 L/s non-clog, horizontal, centrifugal pumps, 2-duty and 1 standby, with motors rated at 18.6 kW for a total dynamic head of 12.2 m.

Waste Water Clarifiers

Solids-contact clarifiers have the following performance characteristics:

| | |
|---|---|
| Number provided | 2 |
| Unit size | 30.5 m dia. x 5.4 m deep (4.88 m SWD) |
| Capacity, design rate | 9,090 $m^3/d$ |
| maximum rate | 27,270 $m^3/d$ |
| Detention time | 8 h @ design flow |
| Internal sludge recirculation rate, approx. | 526 L/s design<br>1578 L/s maximum |
| Surface loading rate | 0.63 m/h design<br>1.58 m/h maximum |
| Flocculator drive | 18.7 kW |
| Detention time in flocculation zone | 0.5 h design |
| Sludge collector drive | 3.73 kW |

Each clarifier is provided with a conical baffled flocculation-reaction zone. Alum or an anionic polyelectrolyte can be added to the waste water flow in the supply pipe to the clarifiers to enhance flocculation and settling. Alum can be added at the in-line blender provided, whereas the polymer can be added downstream of the blender.

Waste Treatment Blender

The performance characteristics of the waste water treatment in-line mechanical blenders are as follows:

| | |
|---|---|
| Number provided | 1 |
| Unit size | 600 mm dia. |
| Capacity, design rate | 18,180 $m^3/d$ |
| maximum rate | 54,540 $m^3/d$ |
| Detention time @ design flow | 0.2 s |
| Motor size | 1.49 kW |
| Velocity gradient, G | 1000 $s^{-1}$ |
| Gt product @ design flow | 200 |

The blender contains two opposed flow impellers similar to those provided for flash mixing. Two chemical injection manifolds are provided - one for alum at the eye of the impellers and one downstream for polyelectrolyte.

## Sludge Transfer Pumps

The sludge collector mechanisms in the clarifiers provide positive mechanical removal of settled sludge to a central discharge hopper. Sludge blowdown from the clarifiers to the sludge holding tanks takes place automatically through a timer controlled sludge blowdown valve. The sludge holding tank has a capacity of 1640 $m^3$ which is sufficient to provide 3-days storage capacity for a sludge pumping rate of 6.3 L/s.

Two non-clog, submersible sludge transfer pumps have been provided. Pumps have a capacity of 20 L/s at 9.15 m total head and a motor rating of 3.7 kW. Space is available for the addition of one future pump.

The level in the sludge tank is monitored at the process controller. Level probes function to automatically control the operation of the sludge pumps.

i) Standby Power

Standby power is available from two Cummins diesel engine generator sets each rated at 230 kW, 250 kVA, 0.8 p.f., 575 V, 3 phase. During a power outage, these units will maintain instrumentation and essential services such as sump pumps and emergency lighting facilities. Standby power for the operation of equipment and pumps is not required since sufficient storage is available in the distribution system and power failures are infrequent.

## C.4 CHEMICAL SYSTEMS

### C.4.1 LIQUID CHEMICAL FEED EQUIPMENT

a) Liquid Alum

The following equipment is available for storing and feeding liquid alum as a primary coagulant to the flash mixers:

- 2 - 158.9 $m^3$ bulk storage tanks, concrete, approx. dimensions 4.6 m W x 7.3 m L x 10.7 m H
- space allowance for 1 future tank
- 5 chemical metering pumps (4 duty, 1 standby), capacity each 0 to 409 L/h at 552 kPa
- flow transmitter on suction side of pump for signal transmission to process controller
- space allowance for future addition of 2-chemical metering pumps for waste water treatment service.

Chemical metering pumps are diaphragm, positive displacement pumps equipped with automatic proportional-to-flow controls; dosage adjustment is remote-manual from the process controller by stroke adjustment. The raw water flow signals for individual pretreatment modules are used for pacing the alum metering pumps.

Manual adjustment of feed pumps can be effected from the analogue control panel and individual local control panels.

b) Polyaluminum Chloride

In mid-September 1986 the plant commenced using polyaluminum chloride as the coagulant.

Equipment available for storing and feeding liquid polyaluminum chloride consists of:

- 2 - 27,000 L bulk F.R.P. storage tanks
- 4 chemical metering pumps, capacity each 0 to 77 L/h at 550 kPa
- flow transmitter for monitoring of flow at the process controller.

Bulk storage tanks and chemical metering pumps were originally intended for storing and feeding cationic and anionic polyelectrolyte solution but these chemicals have not been used yet at the plant.

The four chemical feed pumps, one for each raw water treatment module, are diaphragm, positive displacement units with variable speed SCR drives suitable for automatic quantitative pacing relative to raw water flow for each respective pretreatment module. Dosage adjustment is remote-manual from the process controller by setting length of pump stroke. Manual pump control is available from the analogue control panel.

Pumps take suction directly from bulk storage tanks and deliver liquid chemical to flash mixers.

c) Polyelectrolyte Systems

Facilities exist for storing, preparing and feeding of three different polyelectrolytes simultaneously to three different application points. Under the original design of the plant usage of polyelectrolyte was intended for: i) flocculation aid, ii) filter aid, iii) waste water settling aid, and iv) filter preconditioning. A brief summary of the equipment available for these systems is presented below.

i) Coagulant Aid or Filter Aid

Facilities are available to apply a coagulant aid or filter aid to the process, but not both, since each function requires a different type of polyelectrolyte. As a coagulant aid a low molecular weight cationic polyelectrolyte is required, whereas the filter aid function requires a high molecular weight nonionic polyelectrolyte. The cationic polyelectrolyte would be applied at the flash mixers preferably after the impellers, but the capability exists to also apply the chemical before the impellers. In case of the filter aid service, nonionic polyelectrolyte can be applied to the front end of each of the two pre-filtered water conduits.

In general, the following equipment has been provided for the application of either cationic or nonionic polyelectrolyte:

- 1 - 27,000 L bulk F.R.P. (fibreglass reinforced plastic) storage tank for neat polymer, dimensions 3.05 m dia. by 4.27 m high
- 1 - 900 L F.R.P. tank for activator solution
- 1 - 9,000 L F.R.P. polymer mixing and aging tank, for make-up of 1.5% cationic or nonionic polymer solutions
- 1 - 27,000 L F.R.P. polymer solution storage tank, for make-up and storage of 1.5% cationic polymer solution
- 1 - diaphragm neat polymer transfer pump, capacity 1450 L/h at 550 kPa
- 1 - diaphragm activator transfer pump, capacity 77 L/h at 550 kPa
- 1 - polymer solution progressive cavity transfer pump, capacity 590 L/min. at 270 kPa
- 4 - diaphragm chemical metering pumps, 3 duty and 1 standby, capacity each 77 L/h at 550 kPa
- facilities for adding in-line dilution water after pumps in ratio of 10:1.

Neat polymer and activator transfer pumps are controlled on mix tank level and batch timer; stroke adjustment for qualitative control of solution strength is manual.

Automatic controls (stop/start) on mix tank and solution tank levels are provided for the polymer solution transfer pump.

Chemical metering pumps are equipped with automatic proportional-to-flow controls based on individual raw water flow signals from each pre-treatment module (Module 1, 2, 3 and 4), and remote-manual instrumentation from the process controller for stroke adjustment.

In case of computer failure, feed pumps can be manually adjusted from the analogue control panel and individual local pump control panels.

ii) Filter Preconditioning

Facilities were provided for the application of a liquid nonionic polyelectrolyte to the filter backwash water at the end of a wash for filter preconditioning. The equipment available consists of:

- 1 - 1,140 L F.R.P. storage tank for neat polymer solution supplied in 200 L drums, dimensions 0.91 m dia. by 3.05 m high
- 1 - 90 L P.E. (polyethylene) tank for storage of activator solution
- 1 - 270 L P.E. polymer mixing and aging tank for batch make-up of 1.5% polymer solution
- 1 - 2,280 L F.R.P. polymer solution storage tank
- 1 - diaphragm neat polymer transfer pump, capacity 77 L/h at 550 kPa
- 1 - diaphragm activator transfer pump, capacity 4.5 L/h at 550 kPa
- facilities for transferring polymer solution by gravity through a powered valve to the solution storage tank
- 2 - diaphragm chemical metering pumps, capacity 1500 L/h at 550 kPa
- facilities for adding in-line dilution water after pumps in ratio of 10:1.

The application point provided is located in the backwash water header immediately upstream of the branch header serving the first set of filters. This will be changed to provide individual feed points to each filter.

Quantitative control of metering pumps is automatic by controlling the speed of the pumps relative to the wash water flow signal.

Qualitative control of the feed dosage is achieved by remote-manual setting of the pump stroke from the process controller.

Transfer pumps have automatic stop/start controls on mix tank level and batch timer; qualitative control is manual by stroke adjustment.

When the computer fails the feed system shuts down but can be manually operated from the portable backwash control console.

iii) Waste Water Settling Aid

Waste water treatment facilities available at the Easterly plant were described previously in this section of the report. Provisions for chemical treatment were made and consist of adding alum and/or an anionic polyelectrolyte to the clarifier feed stream. To permit the use of alum as a coagulant, space was provided for the installation of two chemical metering pumps.

The primary option for chemical treatment, however, was the application of an anionic polyelectrolyte as a settling aid, and appropriate storage, make-up and feed equipment has been provided as listed below:

- 1 - 27,000 L F.R.P. storage tank for neat polymer solution
- 1 - 900 L F.R.P. tank for storage of activator solution
- 1 - 9,000 L F.R.P. mixing and aging tank for make-up of 1.5% polymer solution
- 1 - 27,000 L F.R.P. polymer solution storage tank
- 1 - diaphragm neat polymer transfer pump, capacity 1450 L/h at 550 kPa
- 1 - diaphragm activator transfer pump, capacity 77 L/h at 550 kPa
- 1 - progressive cavity polymer solution transfer pump, capacity 590 L/min. at 280 kPa
- 2 - diaphragm chemical metering pumps, capacity 410 L/h at 550 kPa, 1 duty and 1 standby

- facilities for adding dilution water after pumps in ratio of 10:1.

The application point for anionic polymer is in the waste water supply header immediately downstream of the in-line blender.

Transfer pumps have automatic stop/start controls based on mix tank levels and solution tank levels and batch timers; qualitative control is manual by stroke adjustment.

Chemical metering pumps are equipped with automatic quantitative controls for pacing relative to summated waste water flow signal. Qualitative control is achieved by manually setting the pump stroke positioner from the process controller.

Manual control of the chemical feed pumps is available from the sludge transfer pumping panel.

d) <u>Hydrofluosilicic Acid</u>

Hydrofluosilicic acid is applied in the treated water transfer channel at the inlet to the reservoir for fluoridation of the treated water. Storage and feed equipment include the following:

- 2 - 40.9 $m^3$ bulk storage tanks of concrete construction with F.R.P. liner, dimensions are 2.90 m W x 2.74 m L x 5.18 m H
- pneumatic ejector system to transfer bulk acid to 3 - 680 L capacity day tanks positioned on loss-of-weight scales of the load cell type
- weigh scales have electronic, digital read-out cabinets and transmitters
- 3 - 227.3 L/h @ 56.3 m TH diaphragm-type metering pumps complete with automatic proportional-to-flow controls and electric stroke positioners, feed range is 5.90 L/h to 145.5 L/h
- 1 - 22 L capacity acrylic dilution tank and anti-syphon assembly after pumps.

Pumps are arranged for operation in sequence as one duty, one locked out during day tank refilling, and one for standby. Space is provided for installation of three additional pumps in the future.

Pump control is as follows:

- dosage control is achieved by manually adjusting the pump stroke from the process controller
- quantitative control is automatic by SCR drive relative to the total filtered water flow signal.

In the event that the process controller fails, the hydrofluosilicic acid feed system will shut down. The system can then be operated manually from the analogue control panel.

e) Aqua-ammonia

Aqua-ammonia is applied at the south end of the Chemical Mixing Channel at the exit from the Reservoir for ammoniation of the treated water. Available storage and feed equipment consists of:

- 2 - 27,000 L bulk storage tanks of mild steel construction, tank dimensions are 3.05 m dia. by 3.73 m high; space is available for the addition of one future tank
- 2 - 0.303 L/s at 21 m TH transfer pumps, motor rating 0.44 kW
- 2 - 77.3 L/h at 56.3 m TH diaphragm-type chemical metering pumps, 1 duty and 1 standby; pumps are equipped with electric stroke positioners and variable speed SCR drive
- an anti-syphon assembly located in feed line near application point
- 2 - 680 L day tanks mounted on loss-of-weight scales of the load cell type, space is available for one future tank and scale
- weigh scales include electronic, digital read-out cabinets and loss-of-weight transmitters.

Metering pumps are controlled from the process controller. The qualitative dosage rate is set manually at the process controller by adjustment of the pump stroke. Quantitative control is automatic by varying

the speed of the pump relative to the summated treated water flow signal (plant output). Instrumentation for manual adjustments of the aqua-ammonia feed system is available at the analogue control panel.

### C.4.2 GASEOUS CHEMICAL FEED EQUIPMENT

#### a) Chlorine Gas

Chlorine gas in solution form may be applied for 1) prechlorination, 2) postchlorination, and 3) final chlorination. Application points are:

- prechlorination: Raw Water P.S. intake
- postchlorination: outlet of filtered water conduit
- final chlorination: chemical mixing channel near outlet of reservoir.

Storage Equipment

- 46 - 1 ton chlorine containers, 34 in inventory, 12 in service on weigh scales, a second level of storage space is available for future use
- 6 - dual ton container weigh scales, load cell type, digital readout cabinet with loss-of-weight transmitter.

Evaporators and Feeders

- 6 - 3640 kg/d chlorine evaporators (2 per service)
- 6 - 3640 kg/d chlorinators (2 per service) of the vacuum type, complete with automatic plug positioner and proportional-to-flow controls, plug positioner capacities provided are: 1960 kg/d prechlorinators, 2270 kg/d postchlorinators, and 910 kg/d final chlorinators
- injectors are located close to application points
- compound-loop dosage control facilities are available.

b) Sulphur Dioxide Gas

Sulphur dioxide gas is applied in solution form in the chemical mixing channel at the outlet of the reservoir. The equipment available is as follows:

Storage Equipment

- 20 - 1 ton sulphur dioxide containers, 16 in inventory, 4 in service on weigh scales
- 2 - dual ton container weigh scales, load cell type, digital readout cabinet with loss-of-weight transmitter.

Evaporators and Feeders

- 2 - 3640 kg/d sulphur dioxide evaporators
- 3 - 3450 kg/d sulphonators of the vacuum type, complete with automatic plug positioners and proportional-to-flow controls, plug positioner capacities for the three units are 1-1720 kg/d and 2-900 kg/d
- injector is located close to application point.

c) Gaseous Chemical Control Accessories

Gaseous chemical control accessories include:

- 1 local gaseous chemical control panel
- 2 chlorine-in-air gas detectors for alarm purposes, one in each of the equipment room and storage room
- 2 sulphur dioxide-in-air gas detectors for alarm purposes, one in each of the equipment room and storage room
- alarm annunciators mounted locally and at the analogue control panel in the control room
- 7 automatic chlorine residual analyzers for monitoring and control purposes of:

  1 total chlorine residual on:
  - raw water from ring header
  - filtered water from filtered water conduit
  - treated water from treated water suction channel

2) free chlorine residual on:
   - filtered water from filtered water conduit
   - inlet to clear well
   - inlet to clear well plus 30-minutes
   - outlet from reservoir, and
   - south end of chemical mixing channel

- 3 - electronic C-M-A process controllers for quantitative control of pre-, post-, and final chlorination service mounted on the analogue control panel for use during down time of process controller
- 3 - computer manual (C-M) loading stations for qualitative control of pre-, post-, and final chlorinators from the analogue control panel
- manual selector switch with indicator for final chlorine or sulphonator service on analogue control panel, sulphonator dosage adjustment is manual
- caustic soda chlorine gas scrubbing system including 2 - 11,400 L bulk F.R.P. storage tanks and 2 - 15.2 L/s centrifugal transfer pumps with auto (by gas detector) and manual stop/start controls.

Chlorine analyzers function as supervisory monitors and controllers. In each case signals are transmitted to the process controller and the remote indicator at the analogue control panel. For analyzers with a control function, the signal can also be transmitted to the local controller which in turn would adjust the feed rate of the respective chlorinator or sulphonator.

d) Chlorinator-Sulphonator Control

Chlorinators and sulphonators are equipped with compound-loop control instrumentation but, due to problems with instability in the measured variable, feeders have only been operated in the open-loop control mode. Dosage control in the open-loop mode is achieved by automatically pacing feeders proportional to flow. The dosage is adjusted remote-manually from the process controller or the analogue control panel.

Details of the available methods of feeder control are briefly described below.

i) Compound-Loop Control by Process Controller

Prechlorination:
- quantitative flow pacing based on summated raw water flow signal
- qualitative dosage control based on raw water total chlorine residual
- automatic adjustment of set point on raw water chlorine residual analyzer based on total chlorine residual in the filtered water conduit.

Postchlorination:
- quantitative flow pacing based on total filtered water flow signal
- qualitative dosage control based on free chlorine residual as measured in the filtered water conduit
- automatic adjustment of set point on post-chlorine residual analyzer based on free chlorine residual in the clear well.

Final Chlorination and Dechlorination:
- quantitative flow pacing based on summated plant output flow signal
- qualitative dosage control based on free chlorine residual in the chemical mixing channel
- manual adjustment of the set point on the chlorine residual analyzer through the process controller
- automatic selection of final chlorination or dechlorination service based on free chlorine residual in reservoir effluent.

ii) By C-M-A Loading Stations from Analogue Control Panel

Under normal operating conditions, when the computer is out of service the control will be established through C-M-A loading stations at the

analogue control panel. For reasons given previously, the open-loop flow proportional control method would be used for the operation of the chlorinators and sulphonators. However, in the computer mode C-M-A controlers have the capability for operating feeders in the compound-loop control method; quantitative control is based on flow and qualitative dosage control is based on chlorine residual analyzer information. The set point on the controller at the chlorine residual analyzer would be adjusted automatically by a signal transmitted by the C-M (computer-manual) loading station at the analogue control panel.

iii) <u>Manual Control</u>

Manual start/stop controls are available at the equipment as well as through operation of the solenoid valve at the diffuser.

## C.5 SAMPLING

Sample pumps are of the single stage peripheral turbine type except for pumps 11 and 12 on backwash water service, which are submersible centrifugal pumps. Pumps deliver continuously flowing water samples to the following locations and instruments:

- the sample sink in the operator laboratory located in the Chemical Building,
- the sample sink in the main plant laboratory located in the Administration Building,
- on-line monitors/controllers including raw water pH and temperature, turbidity meters, and chlorine analyzers.

Sample pump specifications and information on sampling points, piping sizes, flow velocities and travel times to the point of discharge are presented in Tables C.6 and C.7. It will be noted that travel times to analyzers range from 0.16 to 2.0 minutes and those to sample sinks from 1.4 to 5.2 minutes.

Pumps are constructed of cast iron casings and have cast bronze impellers. Sample pipes are made of Type K copper tubing with soldered connections except for raw water sample lines which are plastic.

TABLE C.6

SAMPLE PUMPS

| Location Sampling Services | Sampling Point | Pump # | Capacity, L/s | Head, m | Rating, kW |
|---|---|---|---|---|---|
| Raw Water P.S. | | | | | |
| - Intake | 1 | 1 & 2 | 0.38 | 53 | 1.12 |
| - Ring Header | 2 | - | | | |
| Filter Building | | | | | |
| - Prefiltered Water Conduit-West | 3 | 3 | 0.38 | 12 | 0.25 |
| - Prefiltered Water Conduit-East | 4 | 4 | 0.38 | 12 | 0.25 |
| - Filtered Water Conduit (Before Post-$Cl_2$) | 5 | 5 | 0.76 | 18 | 0.37 |
| - Clear Well 1 Inlet (After Post-$Cl_2$) | 6 | 6 | 0.76 | 14 | 0.37 |
| - Clear Well 2 Inlet (After Post-$Cl_2$) | 7 | 6 | 0.76 | 14 | 0.37 |
| - Clear Well Inlet Plus 30 minutes | 6 or 7 | 6 | 0.76 | 14 | 0.37 |
| Reservoir Gallery | | | | | |
| - Treated Water Transfer Channel | 8 | 7 | 0.38 | 26 | 0.37 |
| - Reservoir Outlet Channel (Before $SO_2$) | 9 | 8 | 0.76 | 24 | 0.56 |
| - Chemical Mixing Channel (After $SO_2$) | 10 | 9 | 0.76 | 24 | 0.56 |
| - Treated Water Suction Channel (future 12,13&14) | 11 | 10 | 0.76 | 26 | 0.56 |
| Filter Building | | | | | |
| - Backwash Water | 15 & 16 | 11 & 12 | 0.38 | 12 | 0.25 |

TABLE C.7

SAMPLE PIPING CHARACTERISTICS

| Location Sampling Service | Sampling Point | Sample Tap # | Suct./Disch. Piping, mm | Pipe Length, m Suct./Disch. | | Velocity, m/s Suct./Disch. | Total Travel Time, min. |
|---|---|---|---|---|---|---|---|
| Raw Water P.S. | | | | | | | |
| - Intake | 1 | 1 | 38/25 | 23/130 | OL | 0.34/0.78 | 3.9 |
| | | | /25 | 23/108 | ML | " | 3.5 |
| | | | /13 | 23/4 | A-TU1 | 0.34/1.13 | 1.2 |
| - Ring Header | 2 | - | -/19 | -/5 | A-1 | -/0.53 | 0.16 |
| Filter Building | | | | | | | |
| - Prefiltered Water Conduit - W & E | 3 & 4 | 2 | 25/25 | 41 & 49/75 | OL | 0.78/0.78 | 2.6 |
| | | | /25 | 41 & 49/55 | ML | " | 2.1 |
| - Filtered Water Conduit (Before Post-$Cl_2$) | 5 | 3 | 25/25 | 19/133 | OL | 1.55/1.55 | 1.6 |
| | | | /25 | 19/110 | ML | " | 1.4 |
| | | | /13 | 19/8 | A-TU2 | 1.55/1.13 | 0.3 |
| | | | /13 | 19/5 | A-2 | " | 0.3 |
| - Clear Well 1 & 2 Inlet (After Post-$Cl_2$) | 6 & 7 | - | 25/13 | 18 & 12/8 | A-3 | 0.31/1.13 | 0.9 |
| - Clear Well Inlet Plus 30 minutes | 6 & 7 | | 25/19 & 13 | 18 & 12/8 & 8 | A-4 | 0.31/0.54-1.13 | 1.0 |
| | | | /13 | 18 & 12/5 | A-TU3 | 0.31/1.13 | 0.9 |
| Reservoir Gallery | | | | | | | |
| - Treated Water Transfer Channel | 8 | 4 | 32/25 | 9/225 | OL | 0.47/0.78 | 5.2 |
| | | | /25 | 9/202 | ML | 0.47/0.78 | 4.7 |
| - Reservior Outlet Channel (Before $SO_2$) | 9 | 5 | 32/25 | 17/157 | OL | 0.95/1.55 | 2.0 |
| | | | /25 | 17/134 | ML | 0.95/1.55 | 1.7 |
| | | | /13 | 17/10 | A-5 | 0.95/1.13 | 0.4 |
| - Chemical Mixing Channel | 10 | 6 | 32/25 | 20/159 | OL | 0.95/1.55 | 2.1 |
| | | | /25 | 20/137 | ML | " | 1.8 |
| | | | /13 | 20/10 | A-6 | 0.95/1.13 | 0.5 |
| - Treated Water Suction Channel (Plant Output - 2 min, after $NH_3$) | 11 | 7 | 32/25 | 94/126 | OL | 0.95/1.55 | 3.0 |
| | (12, 13 & 14 | | /25 | 94/105 | ML | " | 2.8 |
| | used depending | | /13 | 94/7 | A-7 | 0.95/1.13 | 1.8 |
| | upon plant flow) | | /13 | 94/7 | A-TU4 | 0.95/1.13 | 1.8 |
| Filter Building | | | | | | | |
| - Backwash Water | 15 & 16 | - | 25/13 | 21 & 27/45 | A-TU5 | 0.31/1.13 | 2.0 |
| | | | | /30 | A-TU6 | 0.31/1.13 | 1.7 |

Legend:

- OL - Operator Lab Sample Sink in Chemical Building
- ML - Main Lab Sample Sink in Administration Building
- A-TU1-6 - Turbidity Analyzers
- A-1-7 - Chlorine Residual Analyzers

## C.6 PROCESS AUTOMATION

The Easterly Filtration Plant includes a computer-based monitoring and control system comprising a digital computer and all peripheral hardware and software that will permit the plant to be operated automatically and also manually.

Serving as back up to the process controller, the plant is equipped with a complete analogue supervisory and control system, as well as local supervisory and control panels. Also, a remote telemetering supervisory and control system has been provided for remote manual control of the treated water pumps from the master control centre at the High Level Pumping Station of the distribution system.

In general, the plant is operated in accordance with the following design concepts:

1. The process controller monitors and reports on the status of all systems throughout the plant.

2. The process controller logs all data necessary to establish operating trends and records.

3. Although the process controller is designed for remote control - start, stop and adjust - of much of the mechanical equipment in the plant, normal operation is manual from the control room through the process controller.

4. The treated water pumps under normal operation are controlled remote manually from the master control centre at the High Level Pumping Station. Pumps may be controlled directly by the filter plant operator from the plant control room through the process controller.

5. In the event of failure of the process controller, the filter plant operator supervises the operation of the plant from the control room by means of the analogue back up panel. The analogue

back up panel allows the operator to monitor all critical process variables, alarm conditions and to adjust the chemical feed dosages. A roving operator assists the plant operator to locally start/stop mechanical equipment as necessary.

6. Emergency manual operation is conducted locally at the equipment except for high voltage pumping equipment. Local manual controls for the raw water, treated water, and wash water pumps are located in the associated electrical switchgear rooms, with a lock out-stop push-button at the motor.

7. Chemical feed systems for chlorine and sulphur dioxide are designed for automatic compound loop control through the process controller or analogue back up panel, but are operated in the proportional-to-flow control mode only because chlorine residual analyzers do not function properly all the time. In this operating mode, qualitative adjustment of feeders for dosage setting is done manually from the process controller or analogue control panel.

A listing of the instrumentation hardware available at the plant is given below:

Raw Water Pumping Station

- unit control panels for raw water pumps and discharge modulating valves
- sample pump controls
- intake well level for indication, alarm, low level pump trip-out
- pressure measuring equipment
- equipment for measuring temperature, pH, turbidity and residual chlorine

Treatment Section

- flow measuring equipment for raw water in each pretreatment module, filter effluent, total treated water, plant output as well as backwash water, surface wash and service water

- liquid level measuring equipment for prefiltered water conduits, reservoir, and treated water suction channel
- liquid level controls for sludge pumps
- filter effluent rate controllers
- computer based process controller complete with electrical interface and console
- analogue back up control console with C-M-A and C-M control stations
- portable filter backwash control console
- supervisory control panel
- remote telemetering control panel
- automatic filter backwash program
- measuring equipment for process parameters including turbidity measurement of filter effluent, interface and backwash water, plant output water turbidity, filter loss of head, chlorine residuals for filtered water, after postchlorination, before dechlorination, after dechlorination and after ammoniation
- sample pump control

Chemical Systems

- chlorine feed control equipment
- sulphur dioxide feed system
- alum and polyelectrolyte feed systems equipment
- hydrofluosilicic acid feed equipment
- aqua ammonia feed system
- caustic soda system (for chlorine and sulphur dioxide scrubbers)
- chlorine-in-air gas detector
- sulphur dioxide-in-air gas detector

Treated Water Pumping Station

- treated water pump controls including discharge valves
- wash water pump controls
- local control panels
- flow measurement equipment and controls for backwash water flow rate

- pressure measuring equipment
- local measuring equipment for backwash water pump well, treated water suction channel, and waste water surge tanks
- controls for waste water transfer pumps and process air compressors
- waste water flow measuring equipment.

## C.7 EMERGENCY STANDBY OPERATION

In the event of a power failure all plant operations are shut down. Two standby diesel generators provide power for essential services only including instrumentation equipment, emergency lighting and operation of sump pumps.

## C.8 DRAWINGS

### a) Plant Drawings

Included in this report is a General Site Plan of the Easterly Filtration Plant. This drawing is a reduction of the contract design drawing and bears the reference number 7F-102.

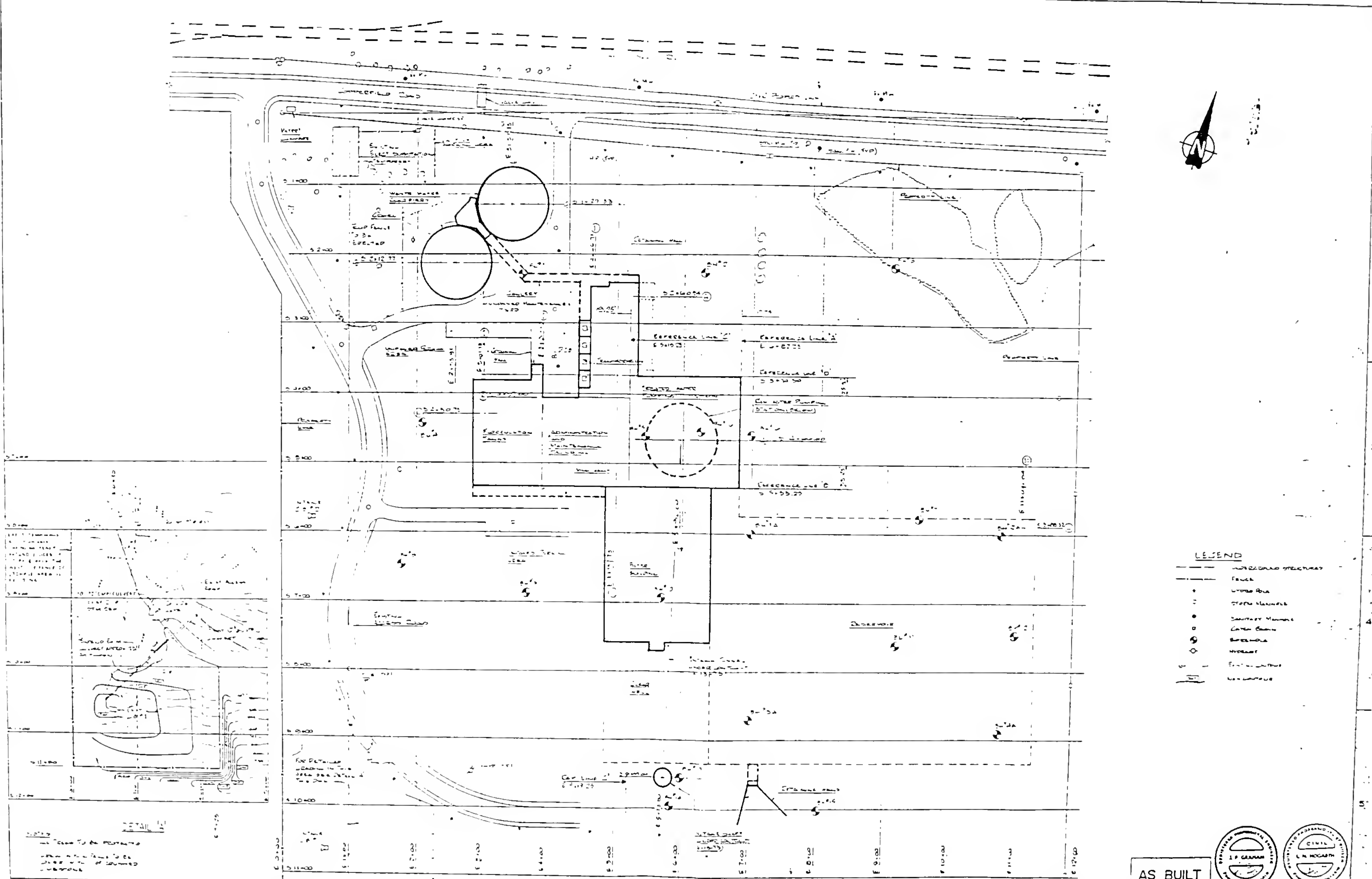
No suitable mechanical process and piping diagram was available in the contract drawings for inclusion in this report.

### b) Process Design Schematic

Figure C.2 presents a process design schematic of the Easterly Filtration Plant.

### c) Plant Photographs

A photographic record is included in this report following Figure C.2. The record is preceded by a photograph index.




| MUNICIPALITY OF METROPOLITAN TORONTO | EASTERLY FILTRATION PLANT | SCALE 1" = 60'-0" | CONTRACT NUMBER W-1-75 |
|---|---|---|---|
| DEPARTMENT OF WORKS | GENERAL SITE PLAN | DATE JAN 1975 | DRAWING NUMBER 7F-102 |

FILE 1555-0-8493

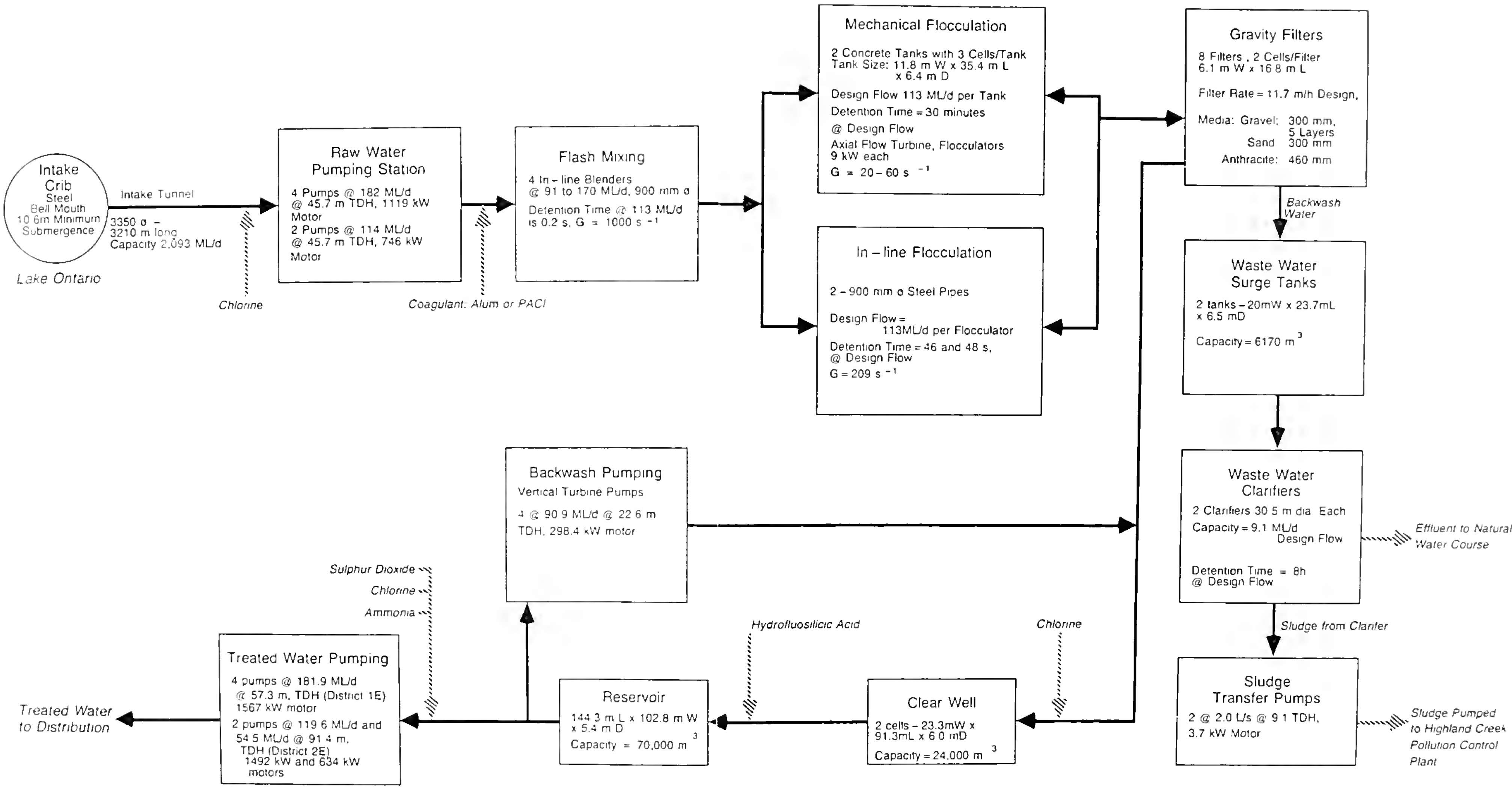



Figure C.2
METROPOLITAN TORONTO EASTERLY FILTRATION PLANT
Process Flow Schematic

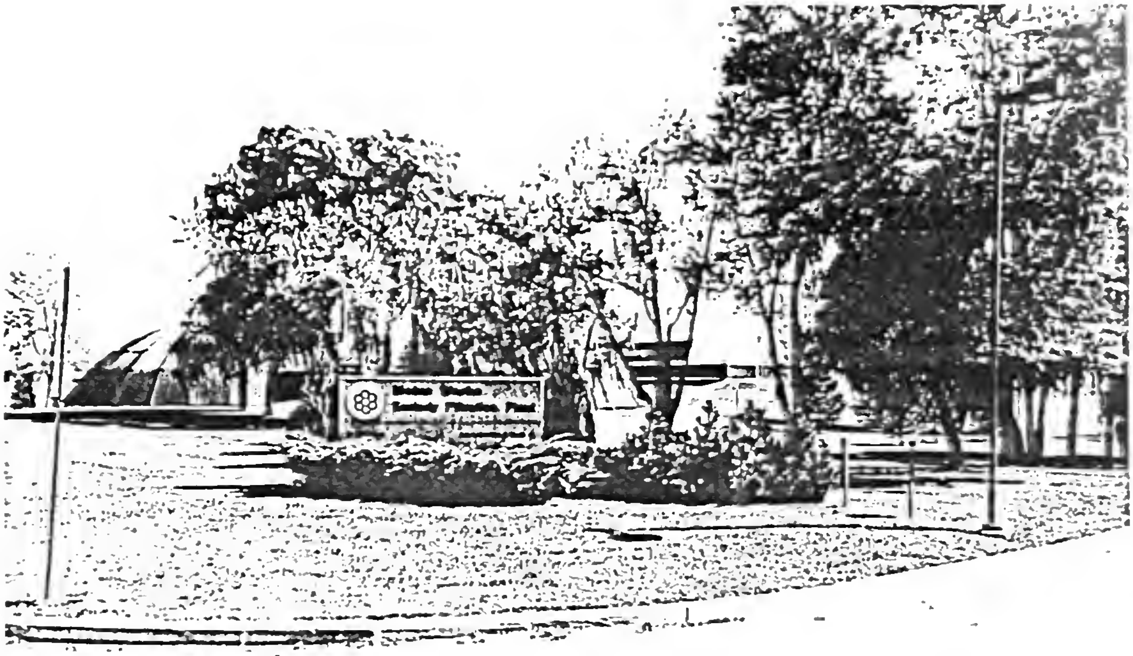
43761

PLANT PHOTOGRAPHS

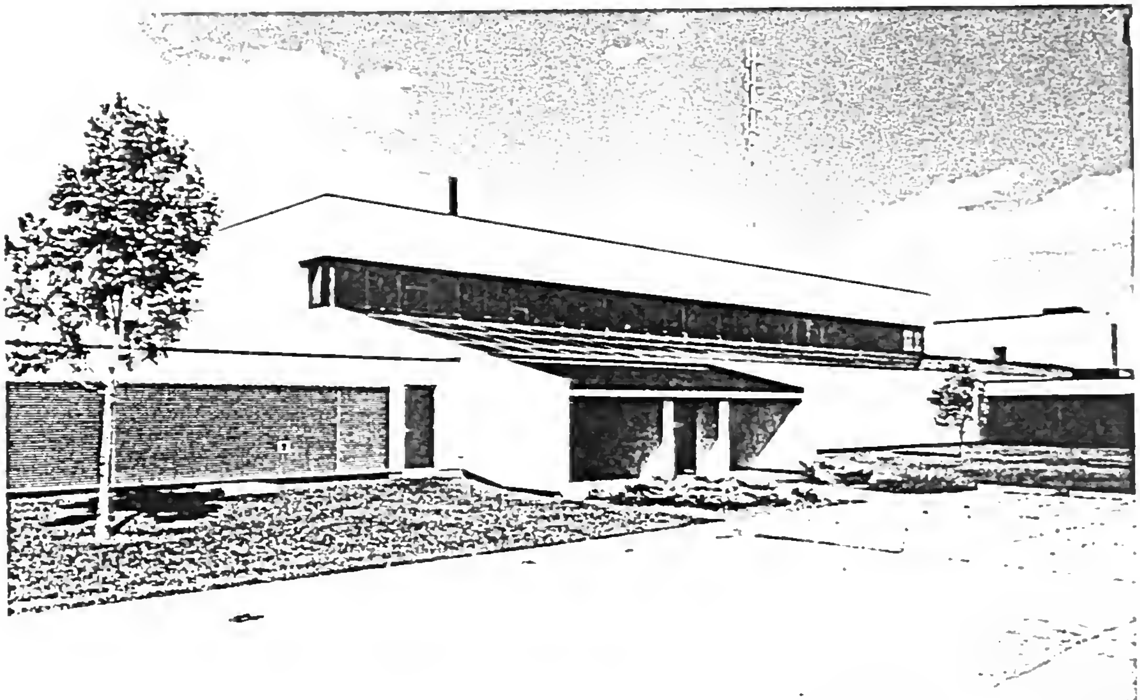
Metropolitan Toronto
Easterly Filtration Plant
Photograph Index

| Photograph No. | Subject |
|---|---|
| 1. | Northwest Elevation - At Entrance to Plant |
| 2. | South Elevation - Administration Building and Main Entrance |
| 3. | West Elevation - Waste Water Clarifiers |
| 4. | North Elevation - Chemical Building and Clarifier |
| 5. | Raw Water Pumps |
| 6. | Raw Water Sample Pumps |
| 7. | In-Line Blenders for Pipe Flocculators |
| 8. | In-Line Pipe Flocculators |
| 9. | In-Line Blender for Mechanical Flocculation Module |
| 10. | Flocculation Tank with Turbine Flocculators |
| 11. | Filter Operating Gallery |
| 12. | Mobile Backwash Control Console |
| 13. | Gravity Filter |
| 14. | Filter Pipe Gallery |
| 15. | Filter Interface and Effluent Turbidity Monitoring Station |
| 16. | Chlorine Residual Analyzers and Controller |
| 17. | Filter Wash Water Pumps |
| 18. | Mechanical Mixer in Reservoir Gallery |
| 19. | Treated Water Pumps - District 1E |
| 20. | Treated Water Pumps - District 2E |

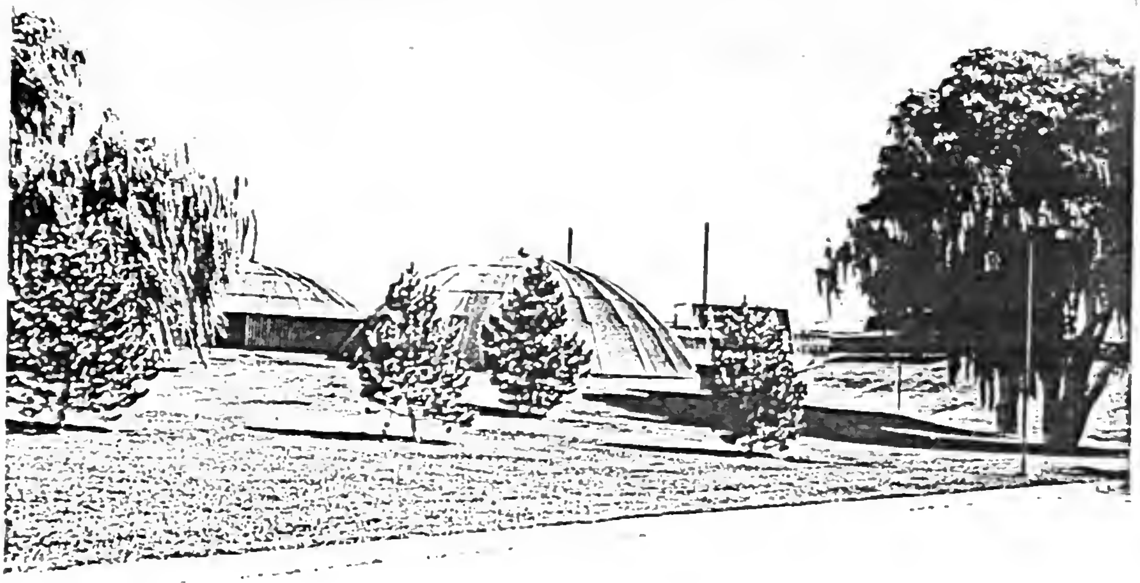
| Photograph No. | Subject |
|---|---|
| 21. | Diesel Generators |
| 22. | Control Room - Computer Console |
| 23. | Control Room - Analogue Back up and Supervisory Control Panels |
| 24. | Chemical Storage and Feed Equipment |
| 25. | Alum Metering Pumps |
| 26. | Polyelectrolyte Metering Pumps |
| 27. | Chlorine and Sulphur Dioxide Storage Room |
| 28. | Sulphur Dioxide Cylinders on Weigh Scales |
| 29. | Chlorinators |
| 30. | Chlorine Analyzers |
| 31. | Aqua-Ammonia Storage Tank and Transfer Pumps |
| 32. | Aqua-Ammonia Day Tank on Scale |
| 33. | Hydrofluosilicic Acid Day Tanks on Scales and Metering Pumps |
| 34. | Operator Laboratory |
| 35. | Main Laboratory |
| 36. | Main Laboratory |
| 37. | Waste Water Transfer Pumps |
| 38. | Waste Water Clarifier |



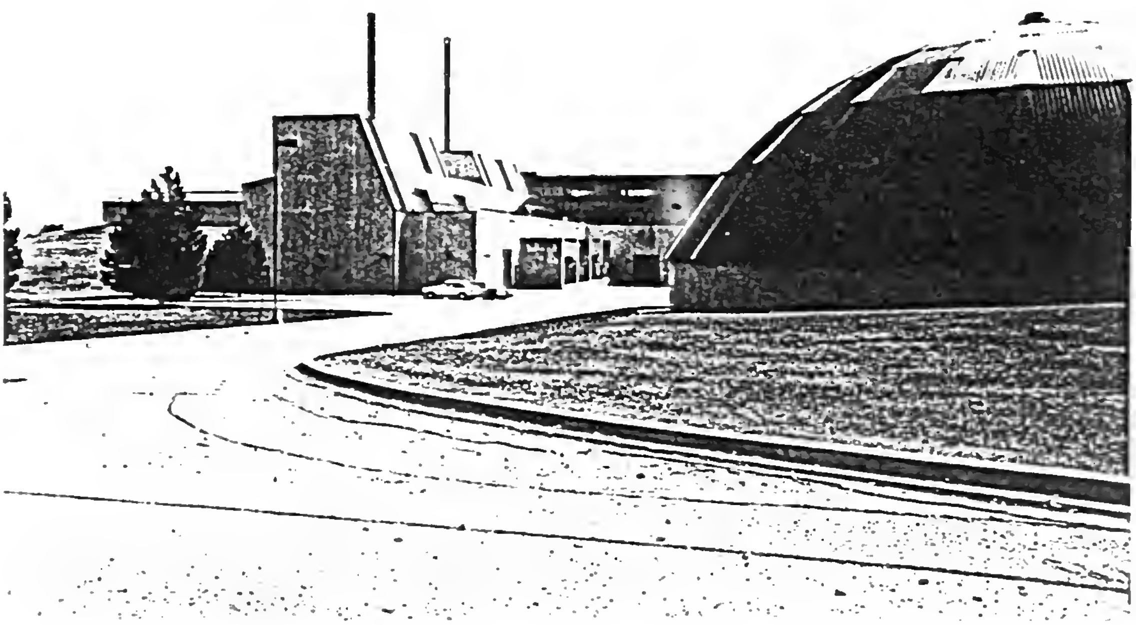
1. Northwest Elevation - At Entrance to Plant



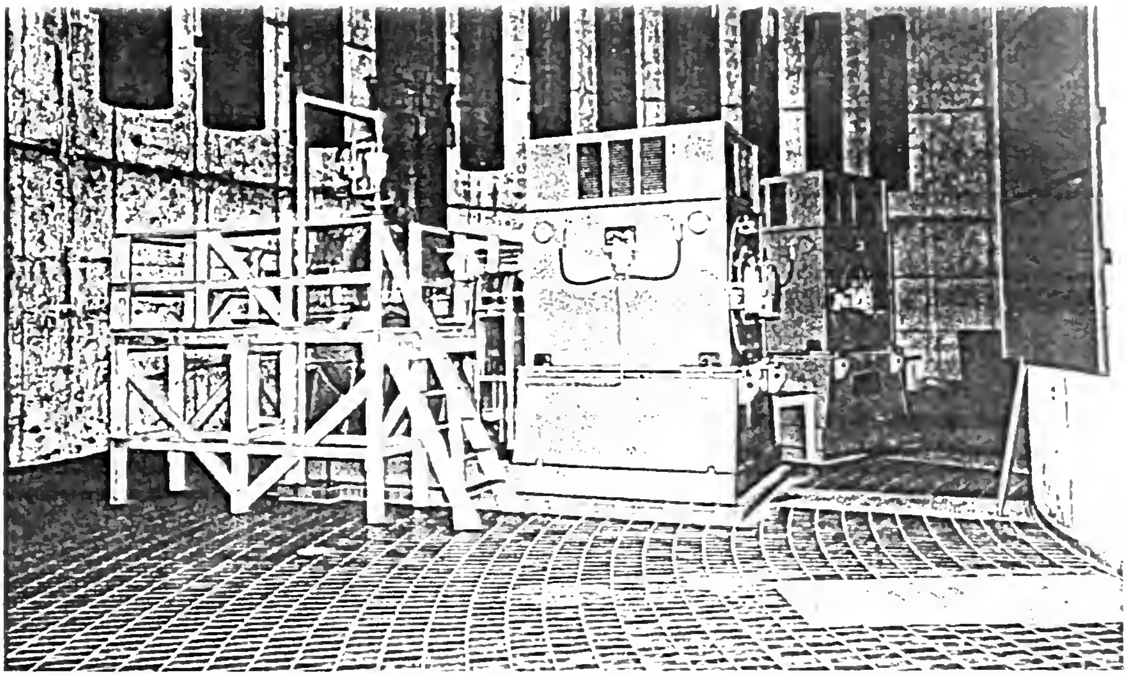
2. South Elevation - Administration Building and Main Entrance



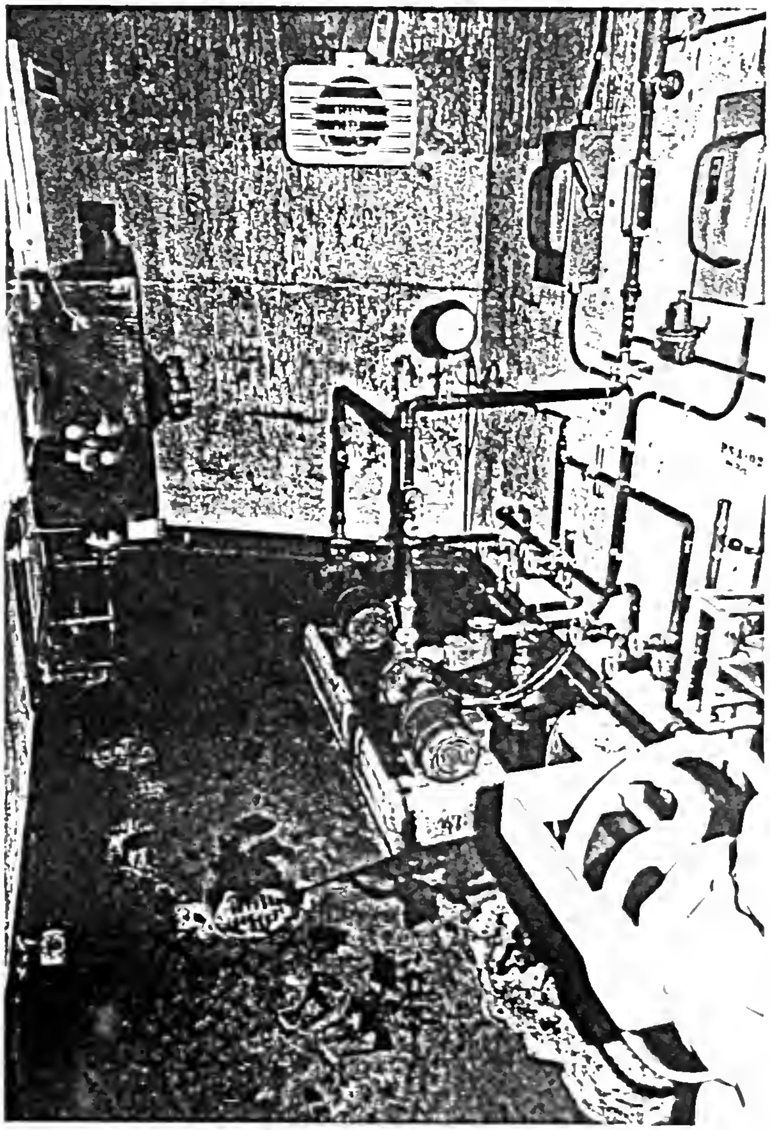
3. West Elevation - Waste Water Clarifiers



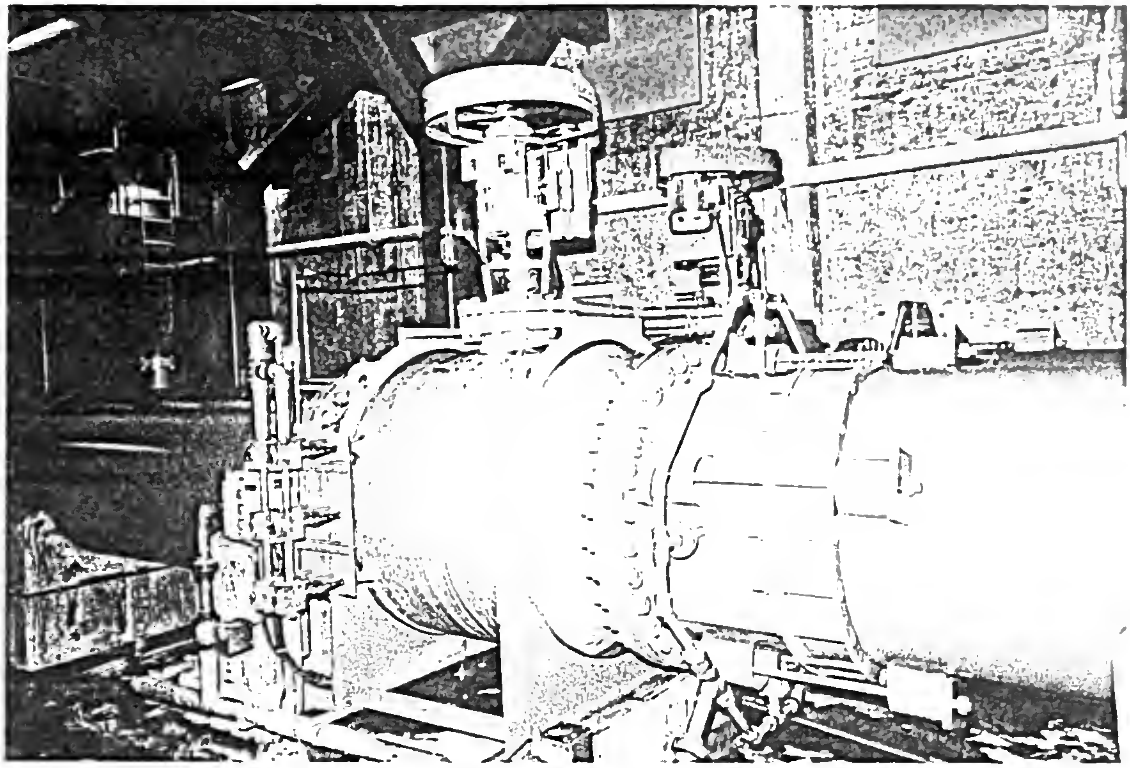
4. North Elevation - Chemical Building and Clarifier



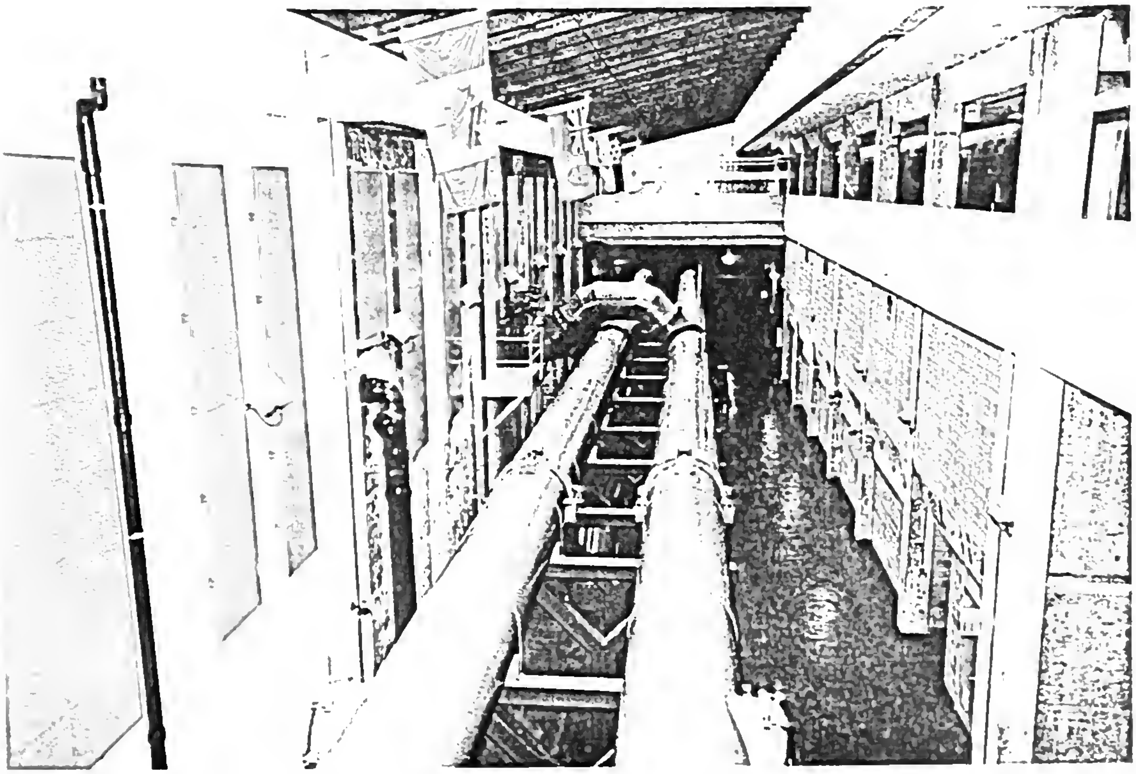
5. Raw Water Pumps



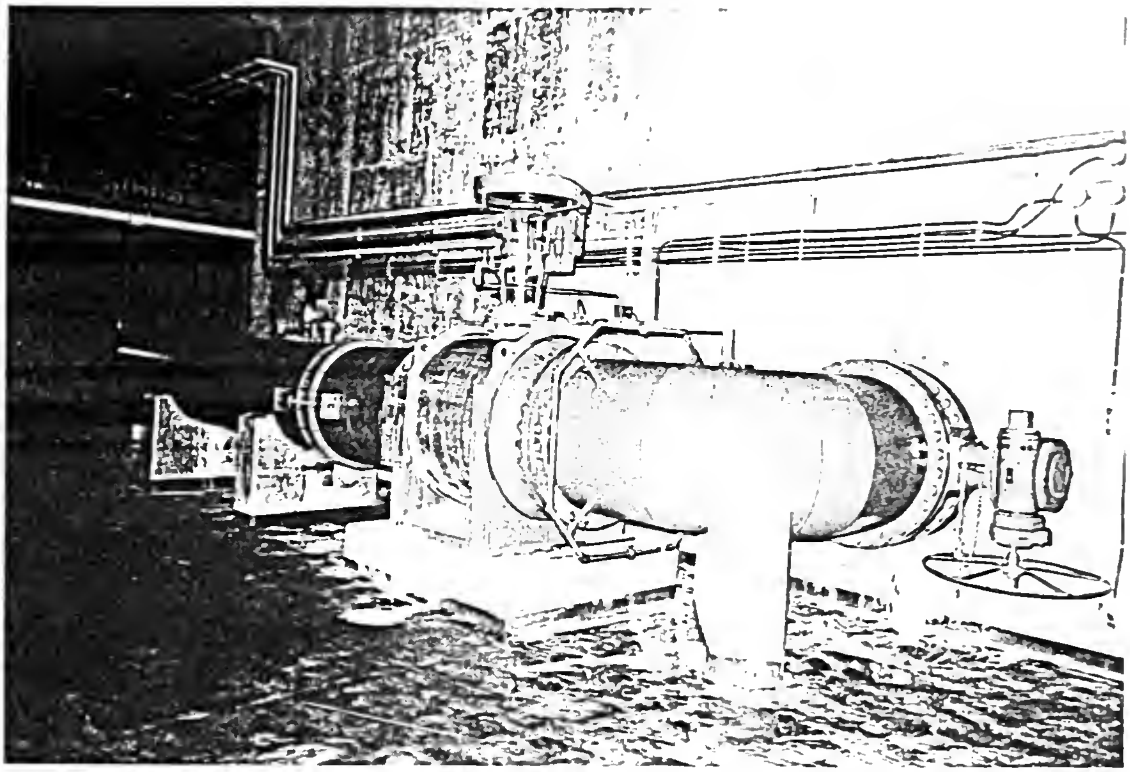
6. Raw Water
Sample Pumps



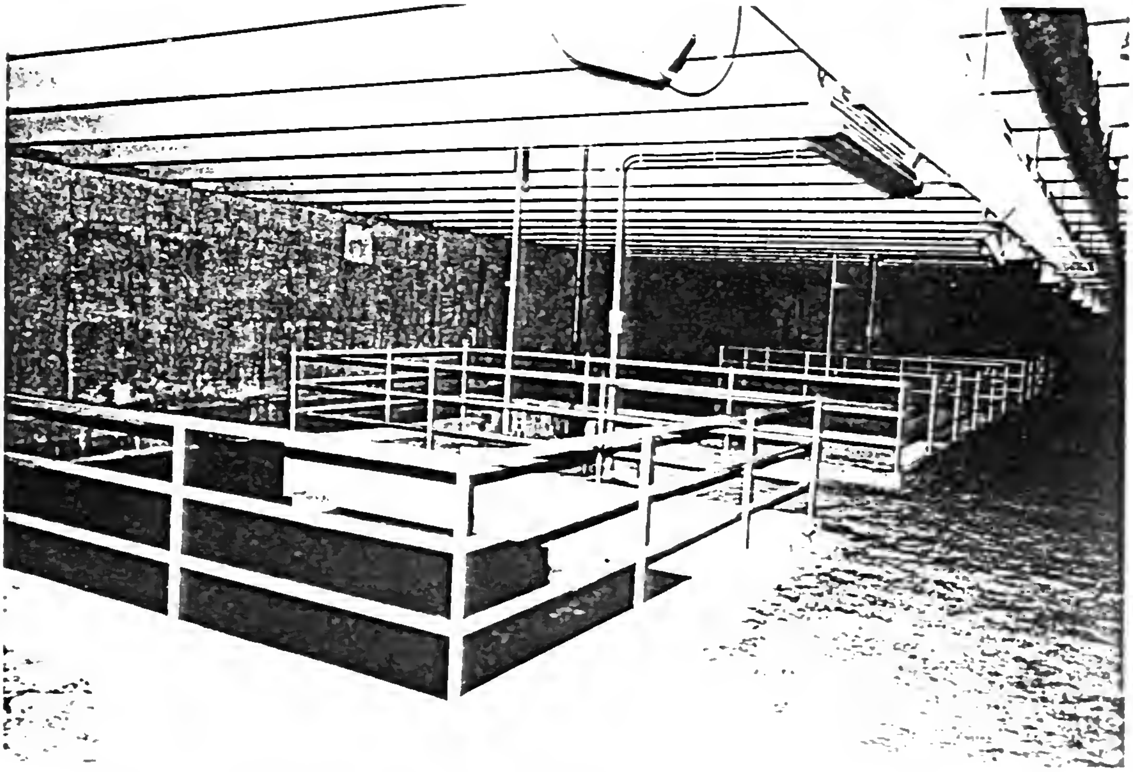
7. In-Line Blenders for Pipe Flocculators



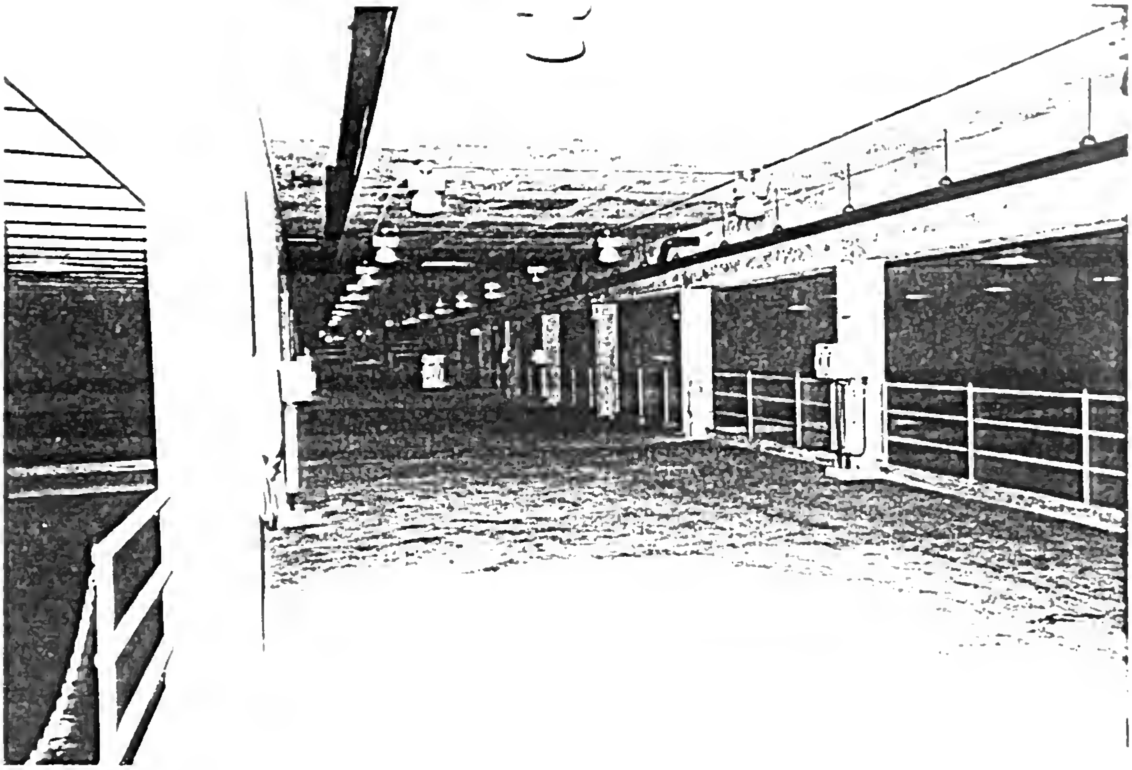
8. In-line Pipe Flocculators



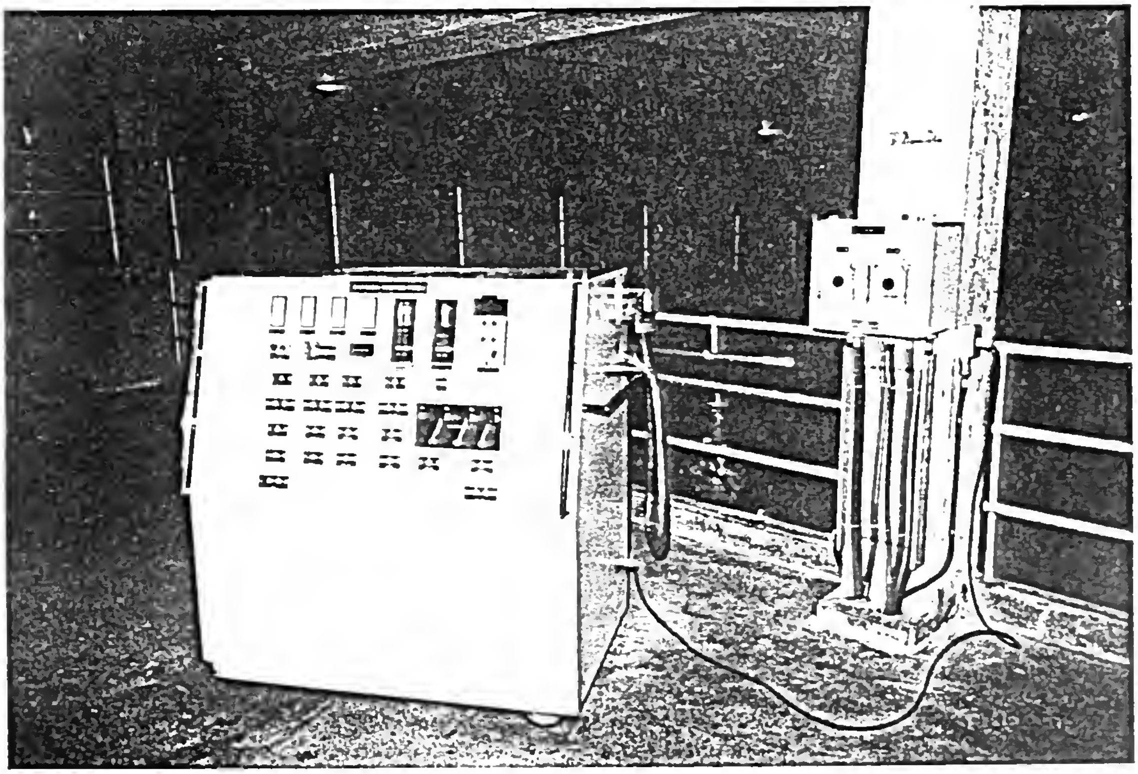
9. In-Line Blender for Mechanical Flocculation Module



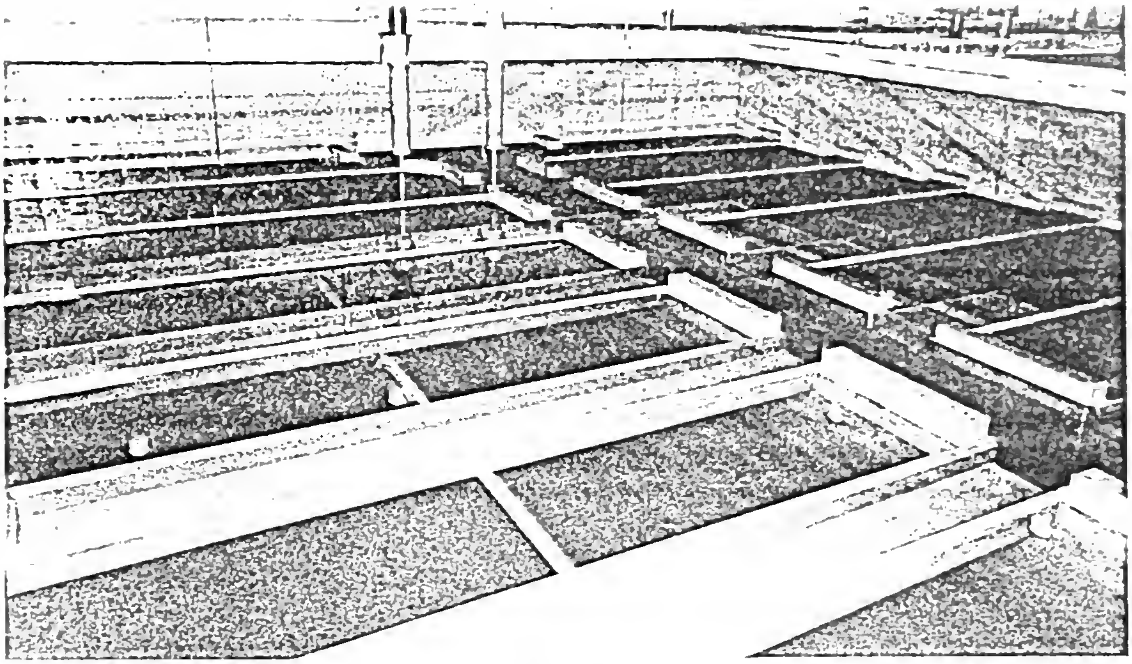
10. Flocculation Tank with Turbine Flocculators



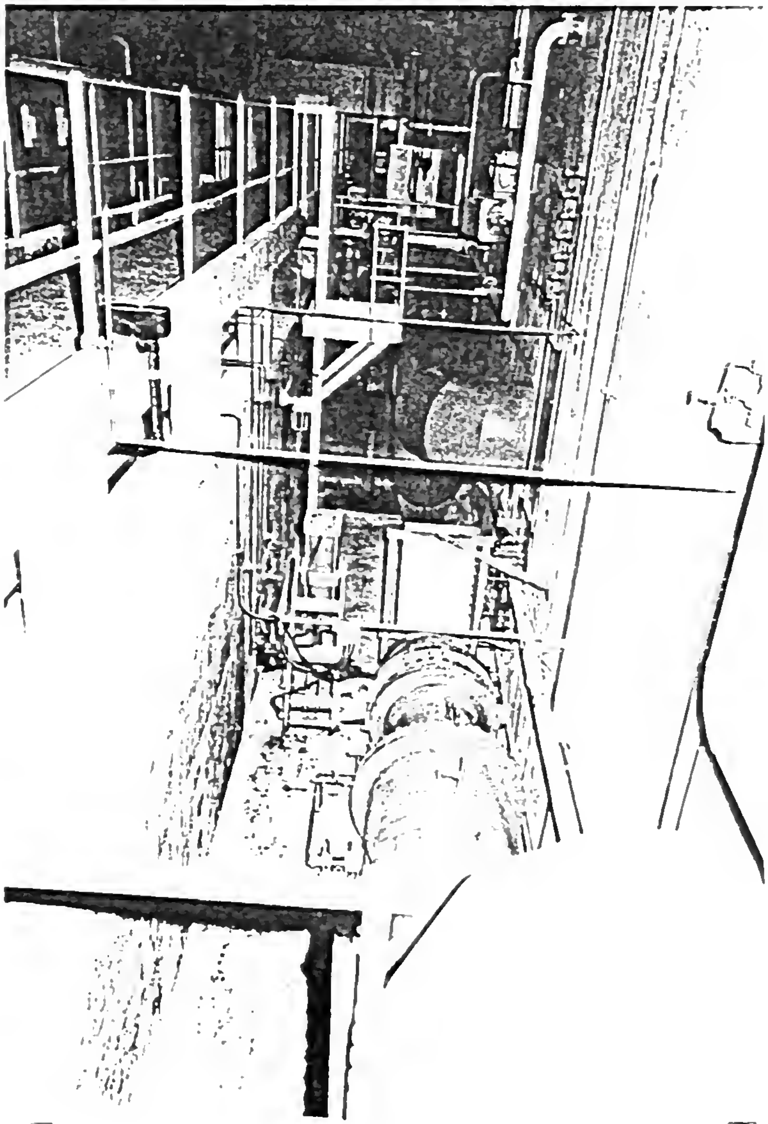
11. Filter Operating Gallery



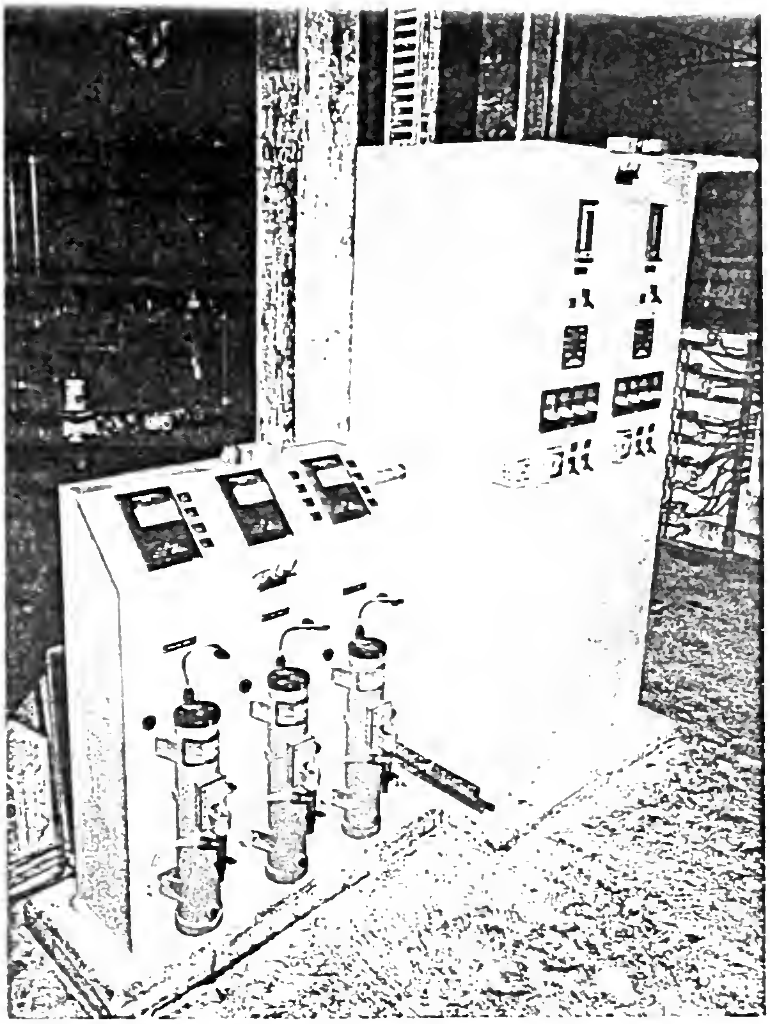
12. Mobile Backwash Control Console



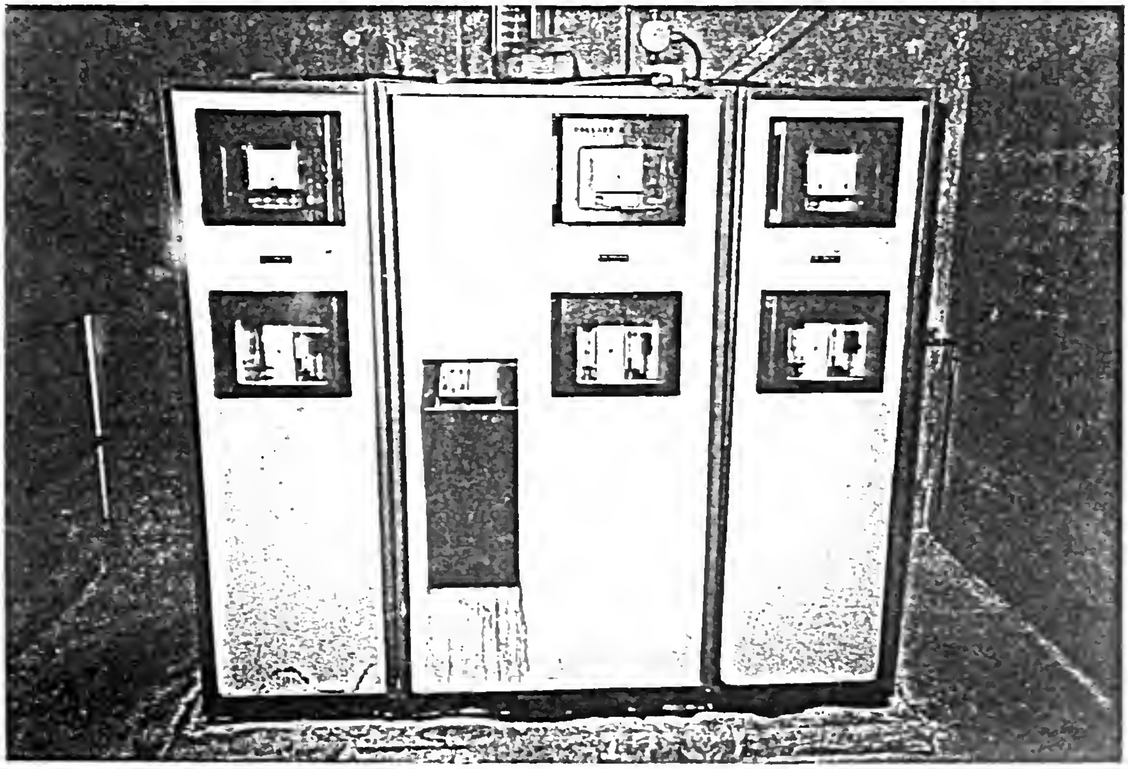
13. Gravity Filter



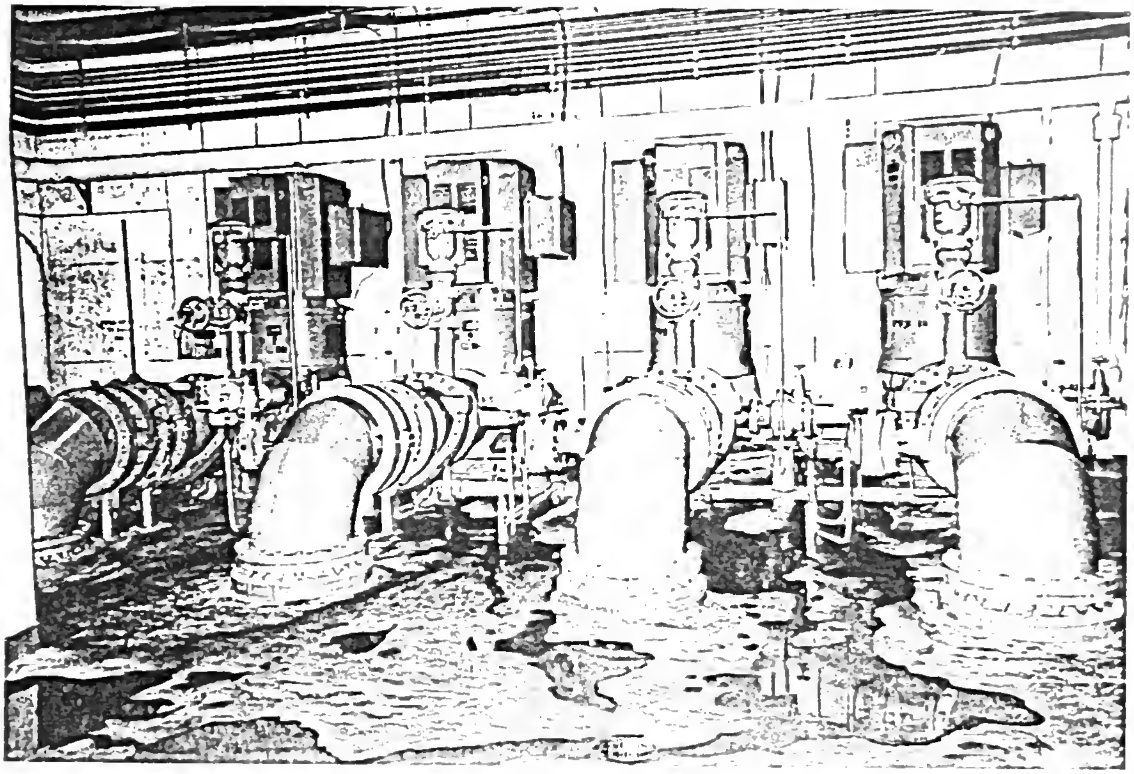
14. Filter Pipe Gallery



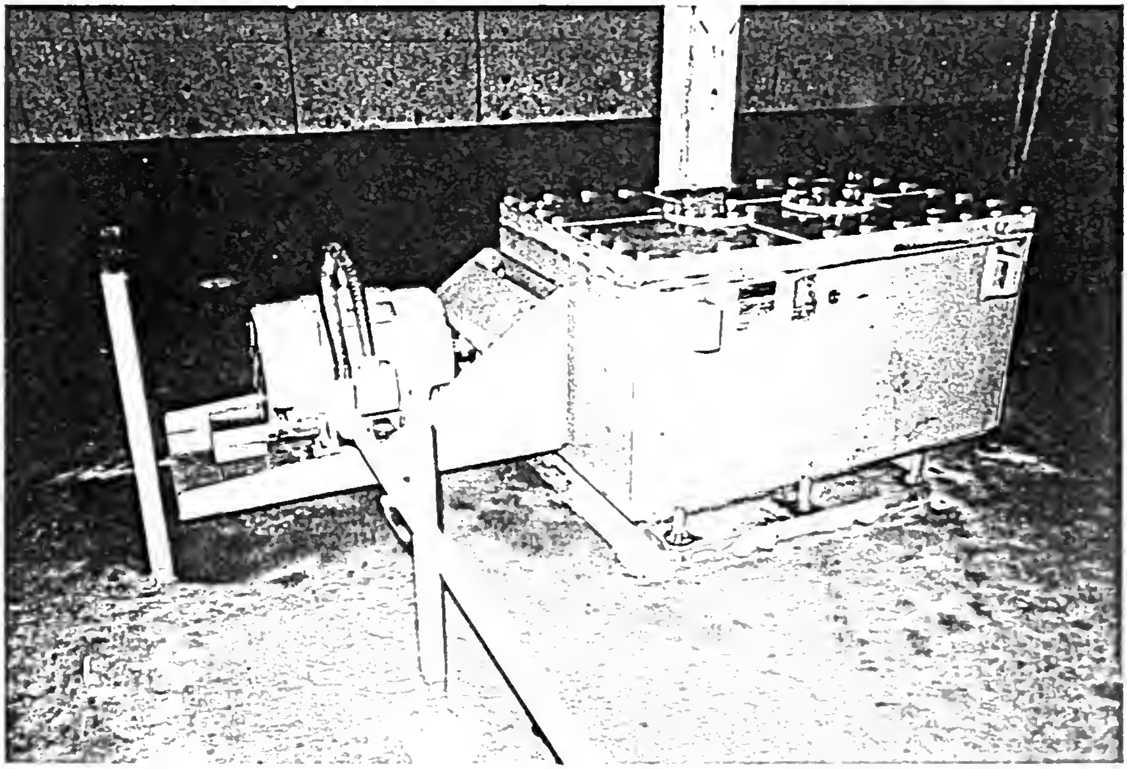
15. Filter Interface and Effluent Turbidity Monitoring Station



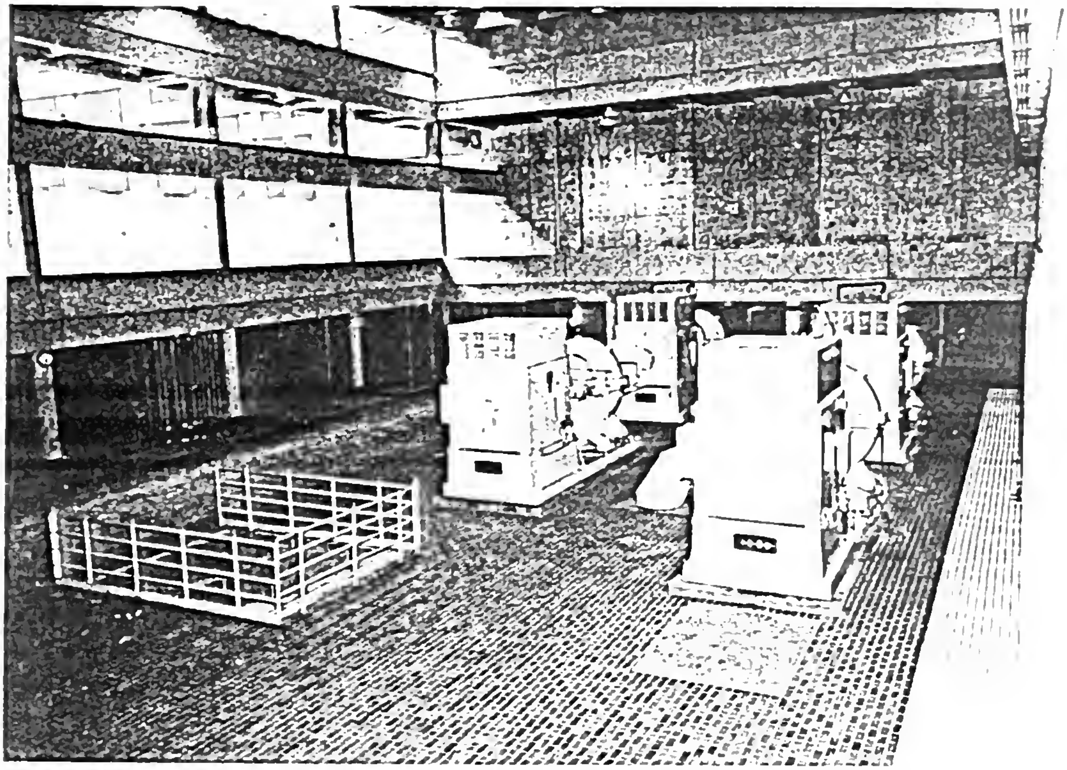
16. Chlorine Residual Analyzers and Controller



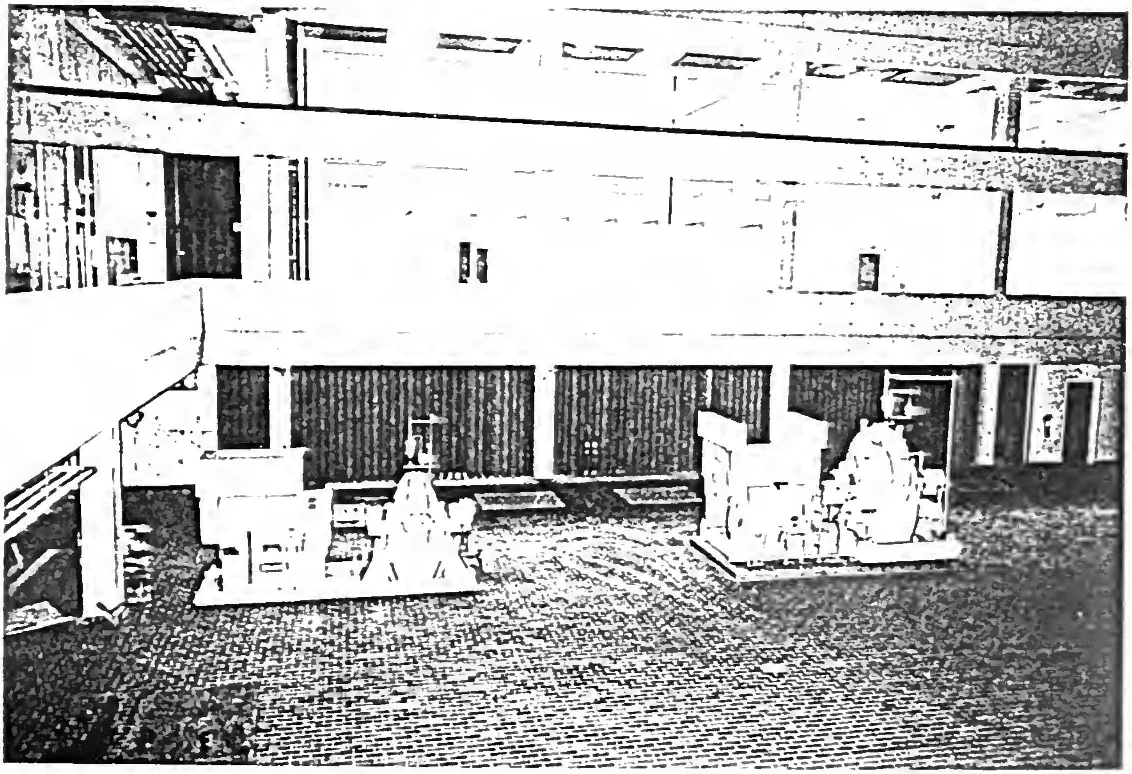
17. Filter Wash Water Pumps



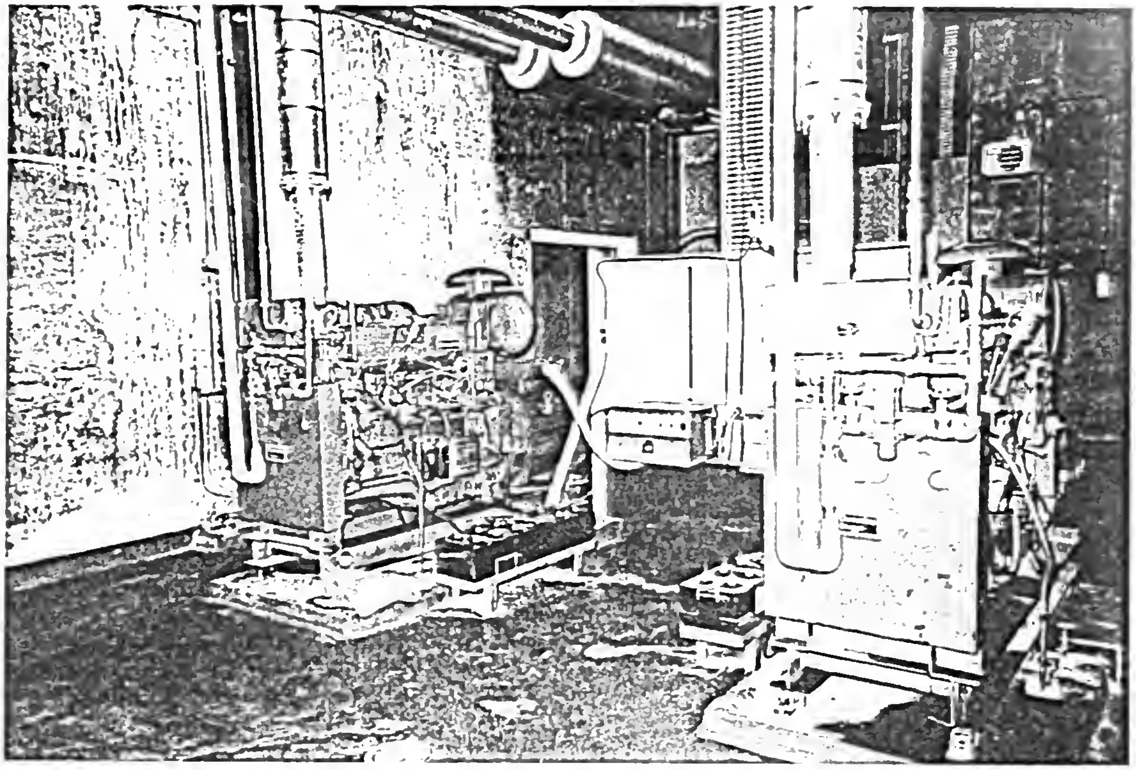
18. Mechanical Mixer in Reservoir Gallery



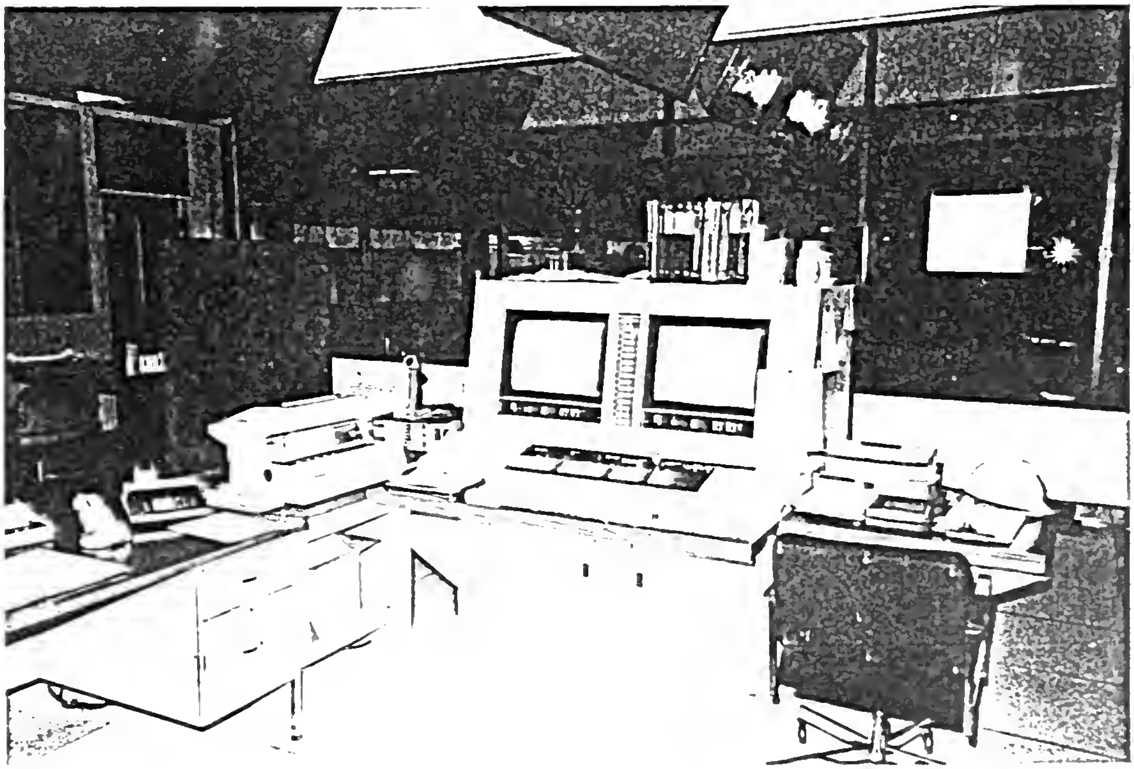
19. Treated Water Pumps - District 1E



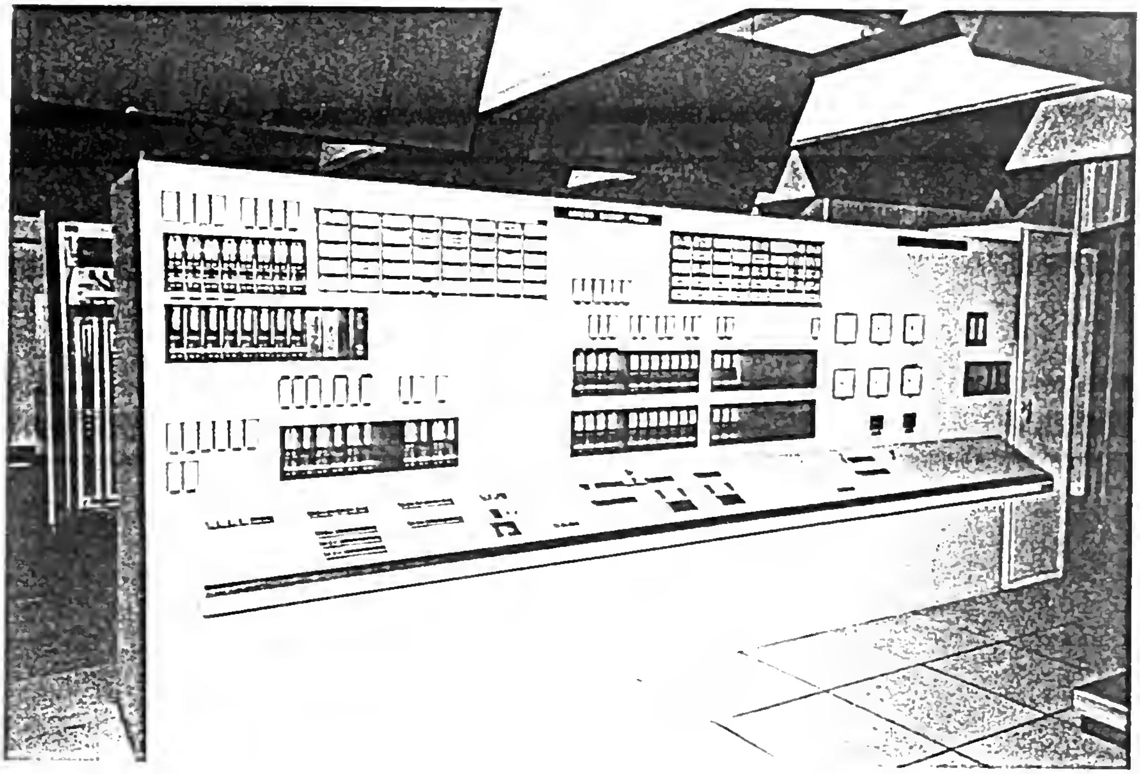
20. Treated Water Pumps - District 2E



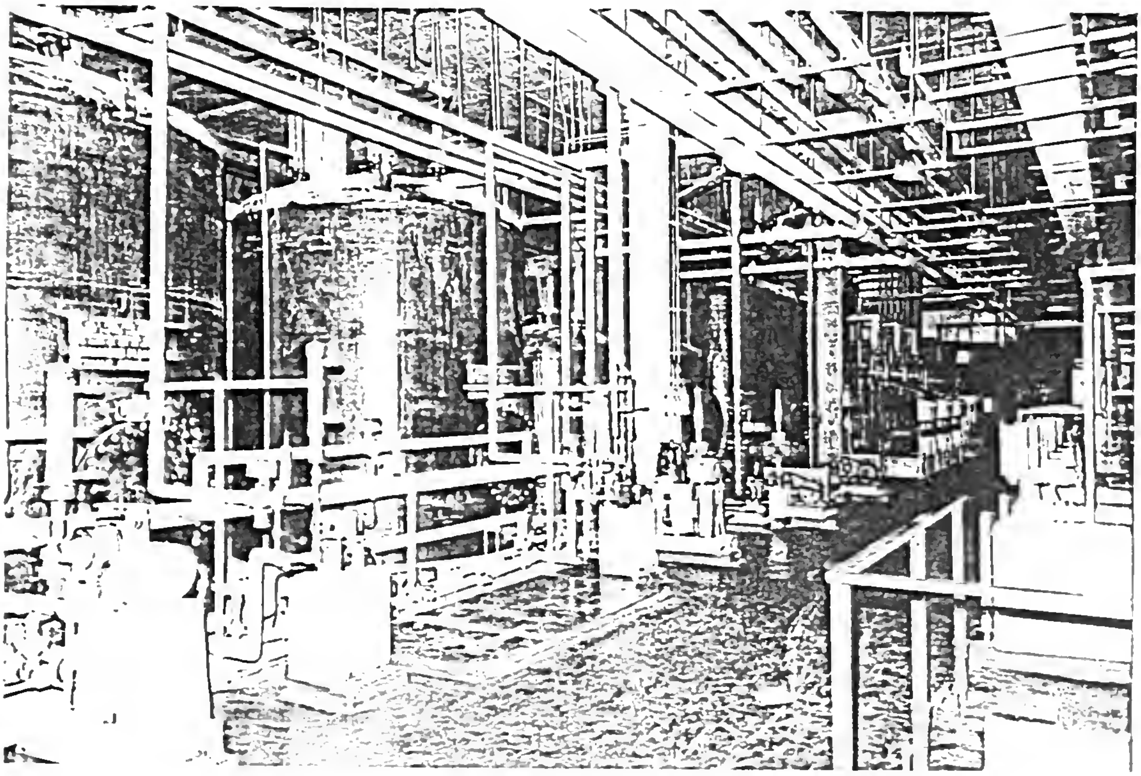
21. Diesel Generators



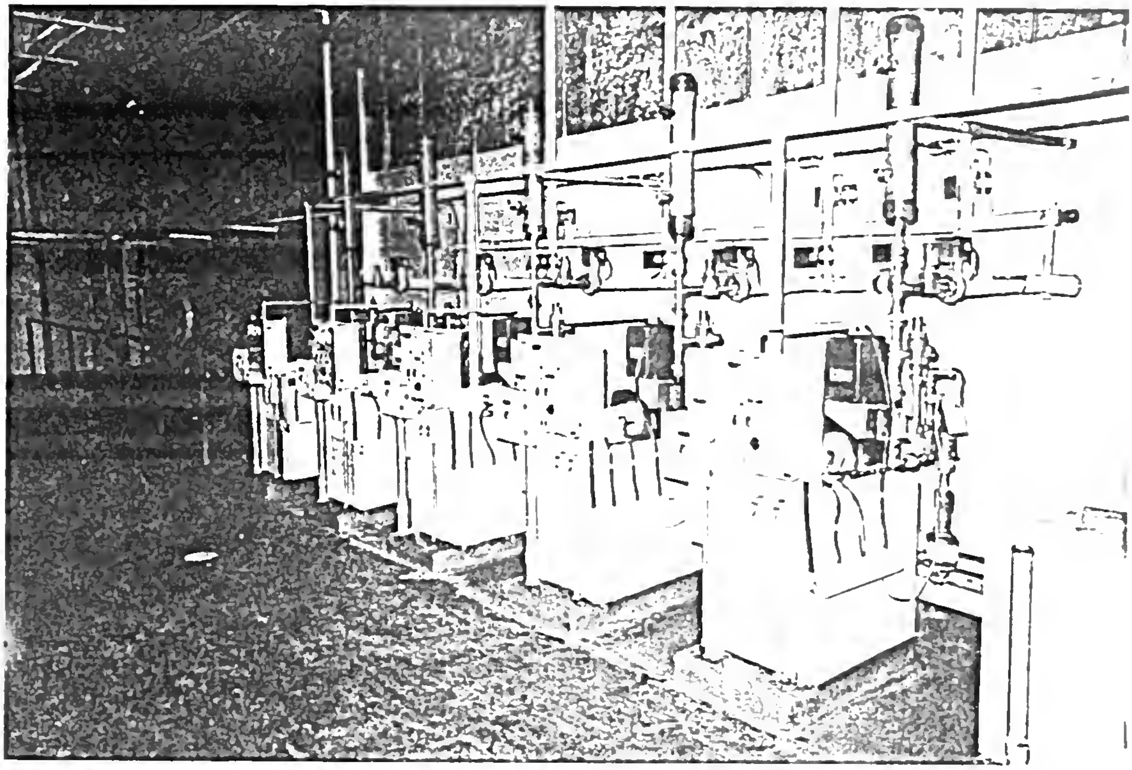
22. Control Room - Computer Console



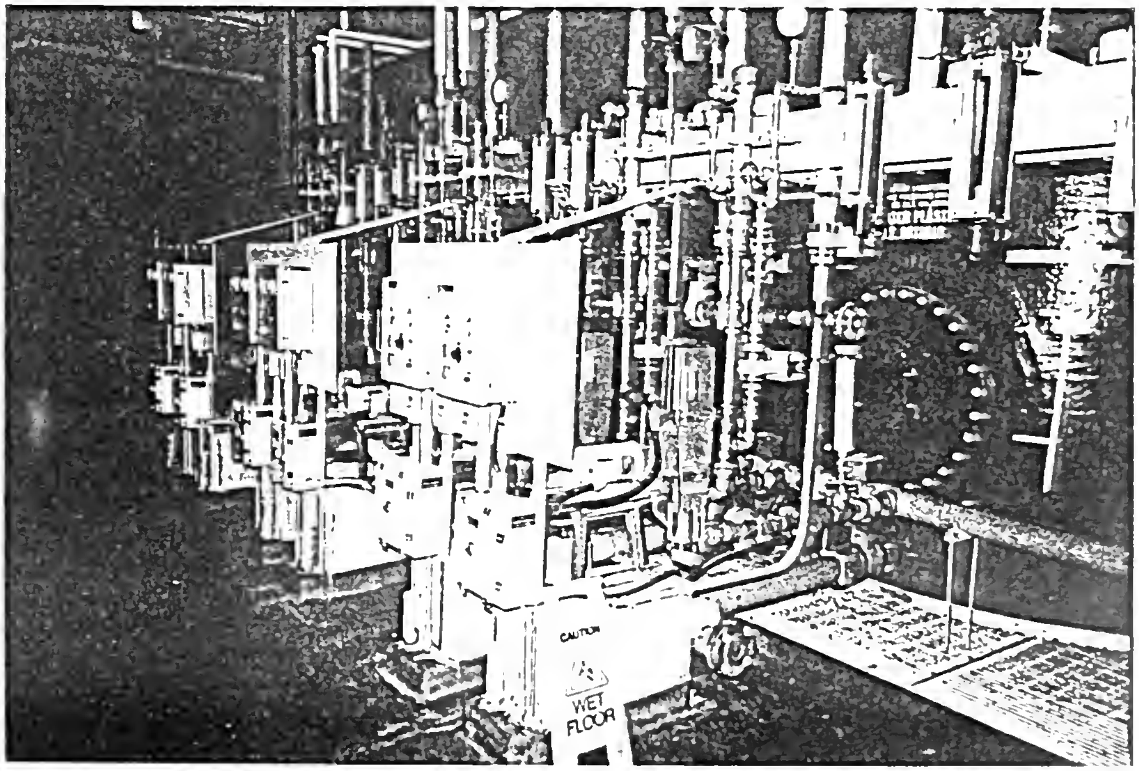
23. Control Room - Analogue Back up and Supervisory Control Panels



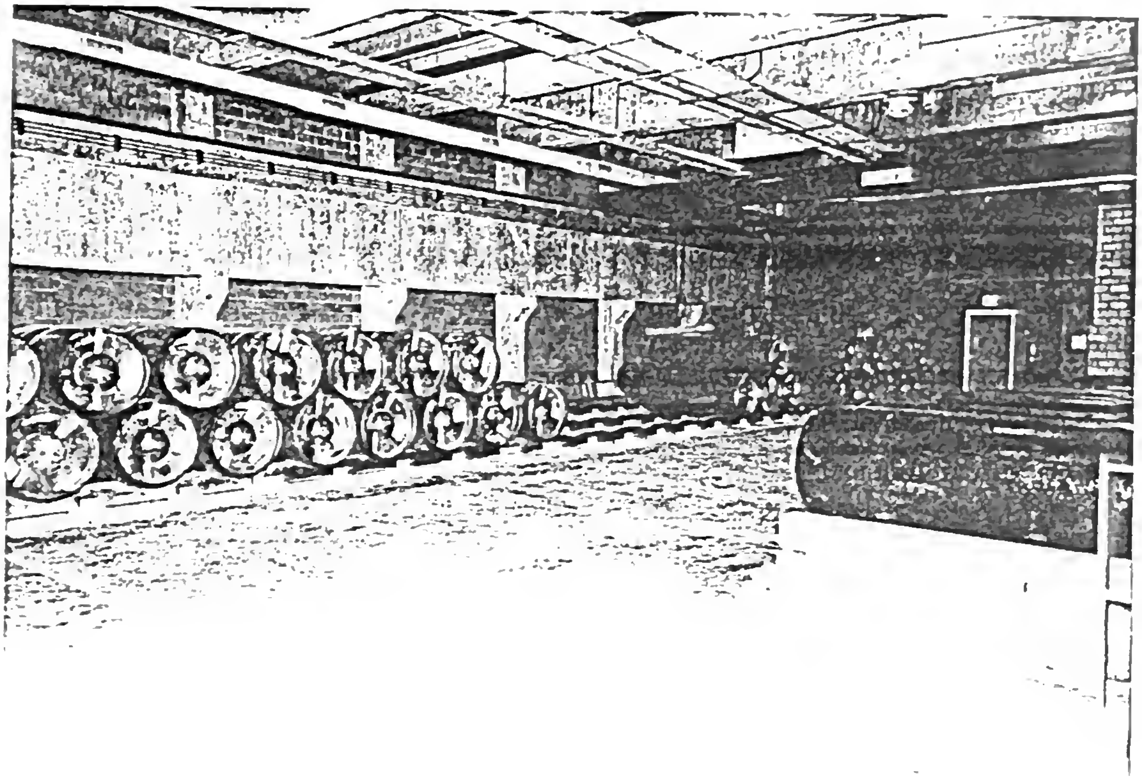
24. Chemical Storage and Feed Equipment



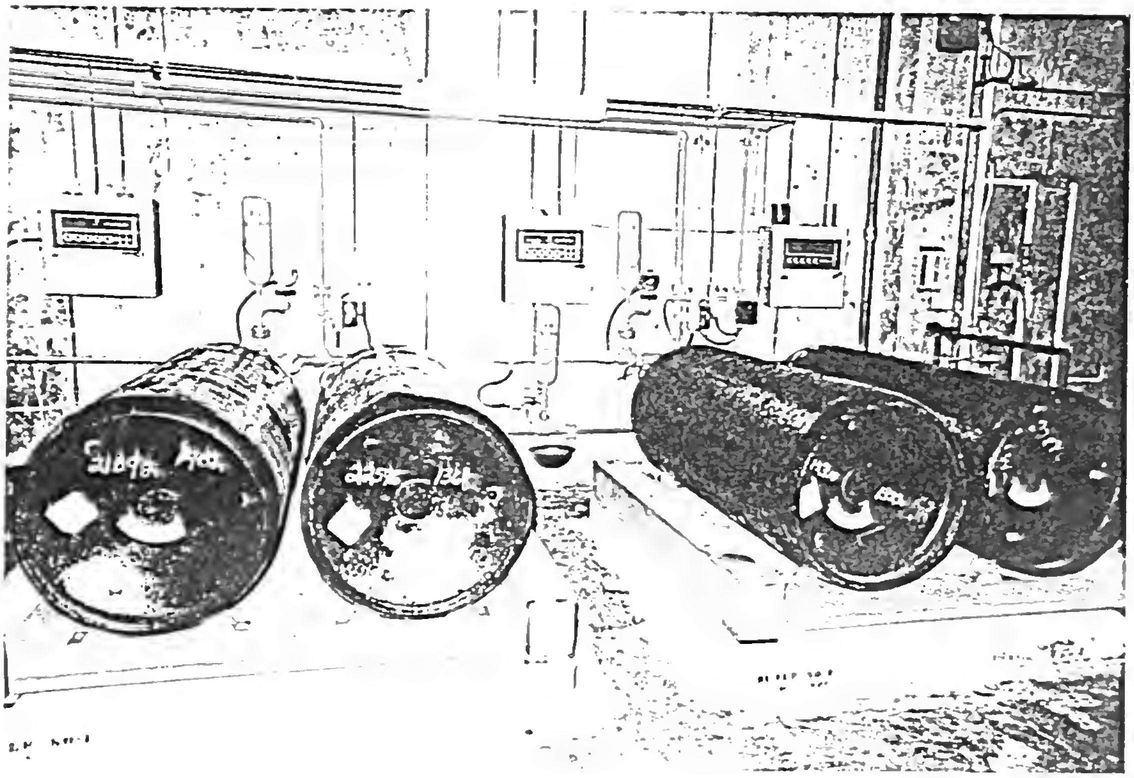
25. Alum Metering Pumps



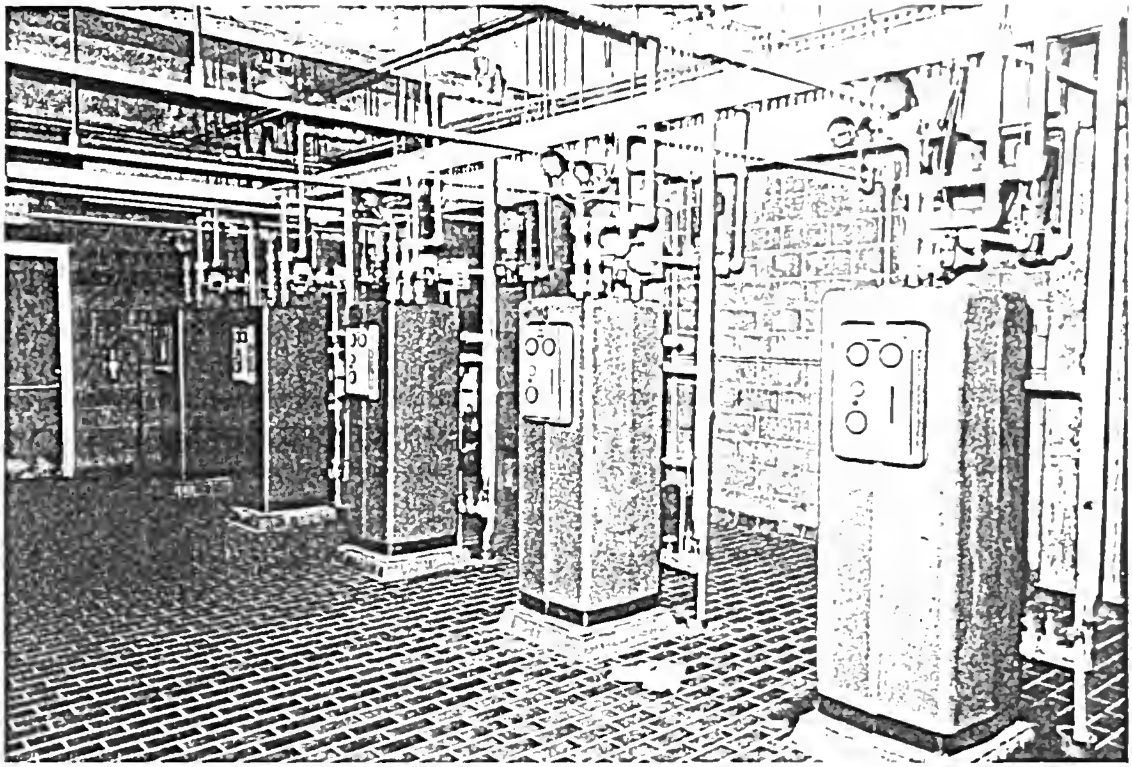

26. Polyelectrolyte Metering Pumps



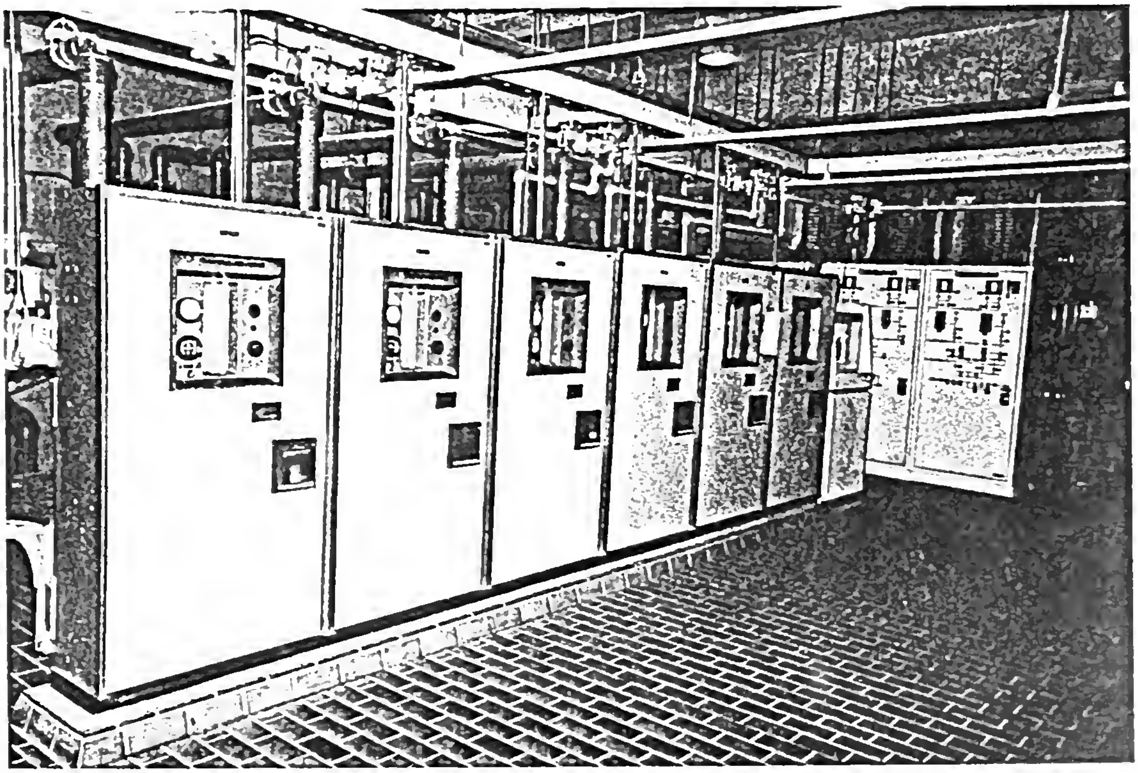
27. Chlorine and Sulphur Dioxide Storage Room



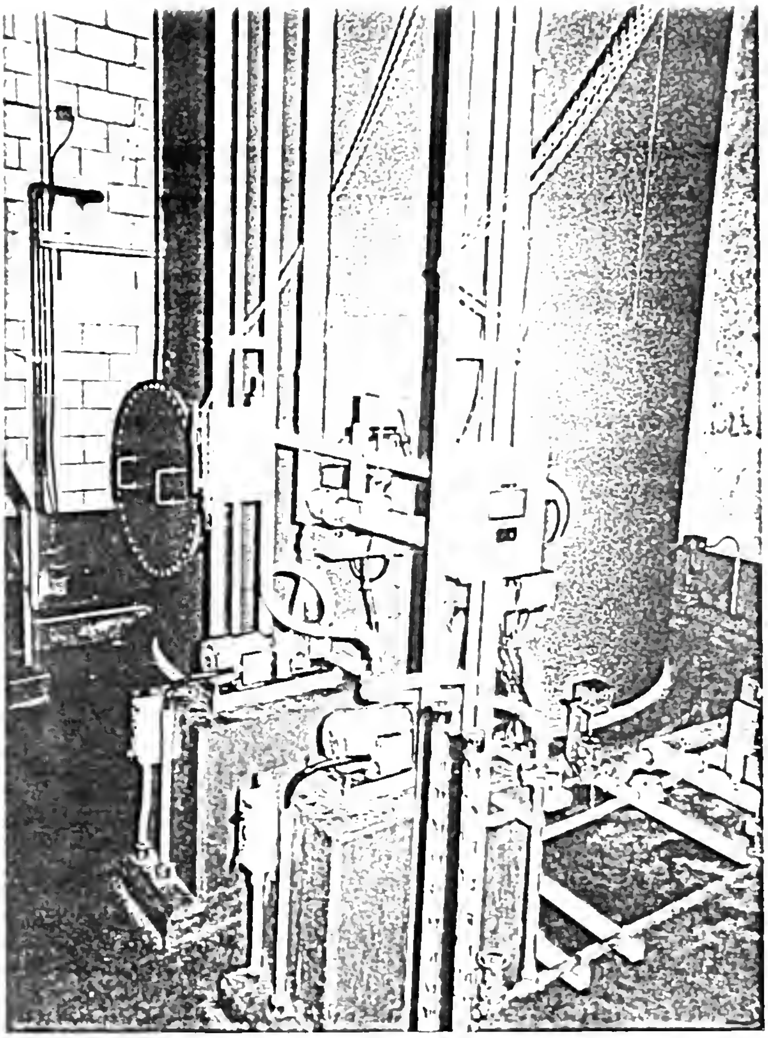
28. Sulphur Dioxide Cylinders on Weigh Scales



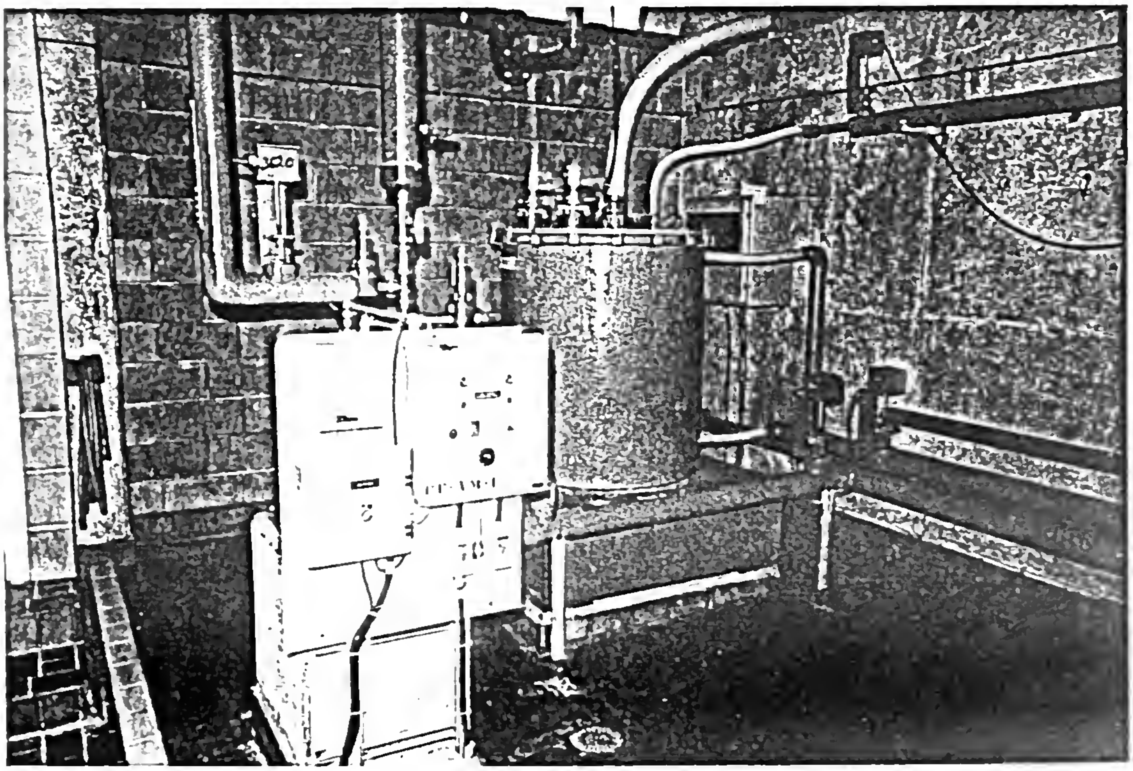
29. Chlorine Evaporators



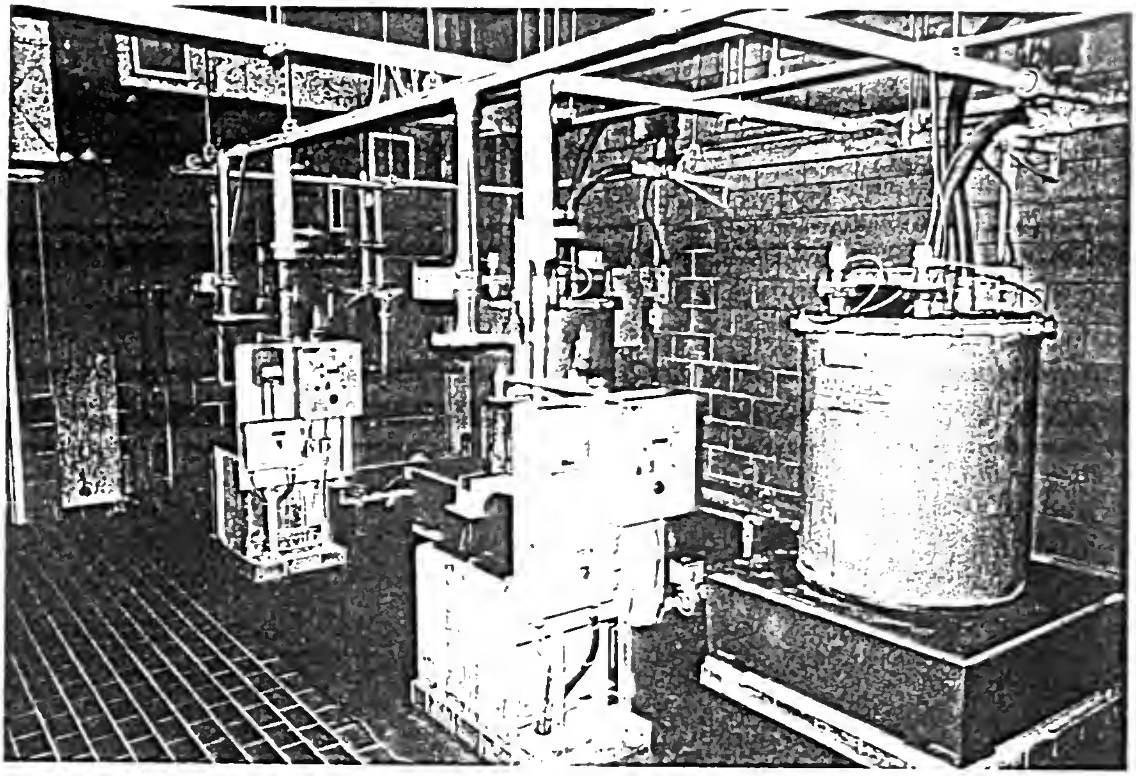
30. Chlorinators



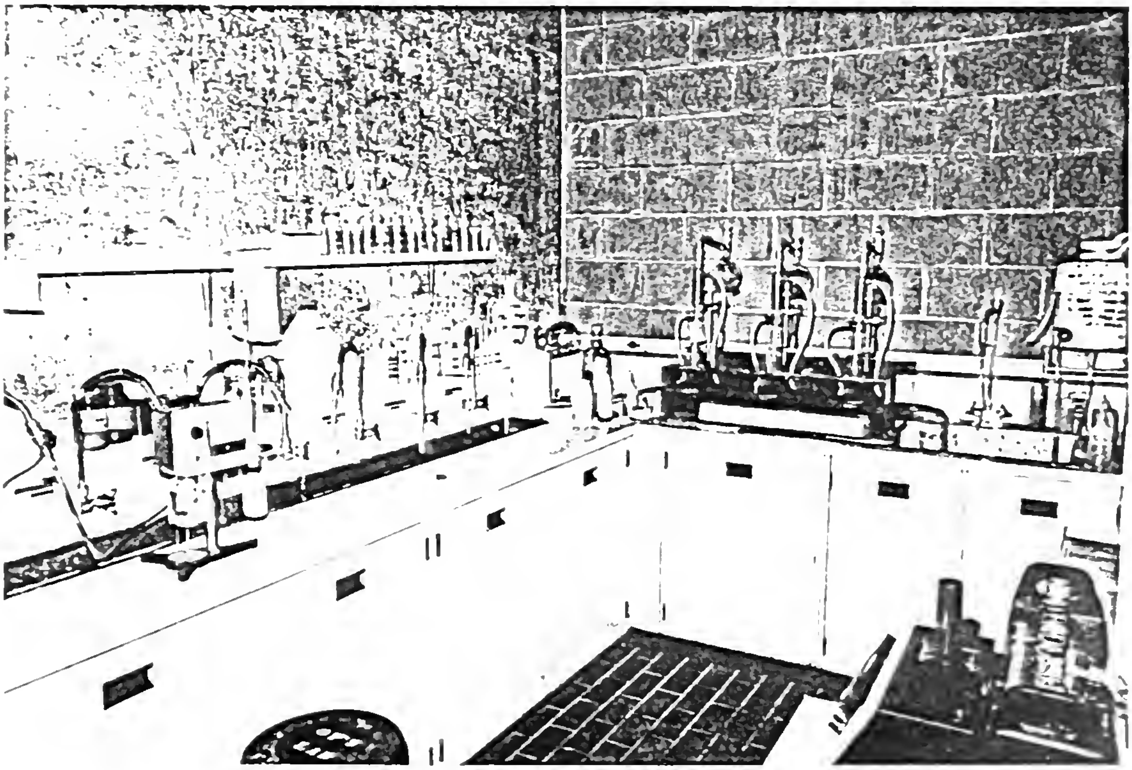
31. Aqua-Ammonia Storage Tank and Transfer Pumps



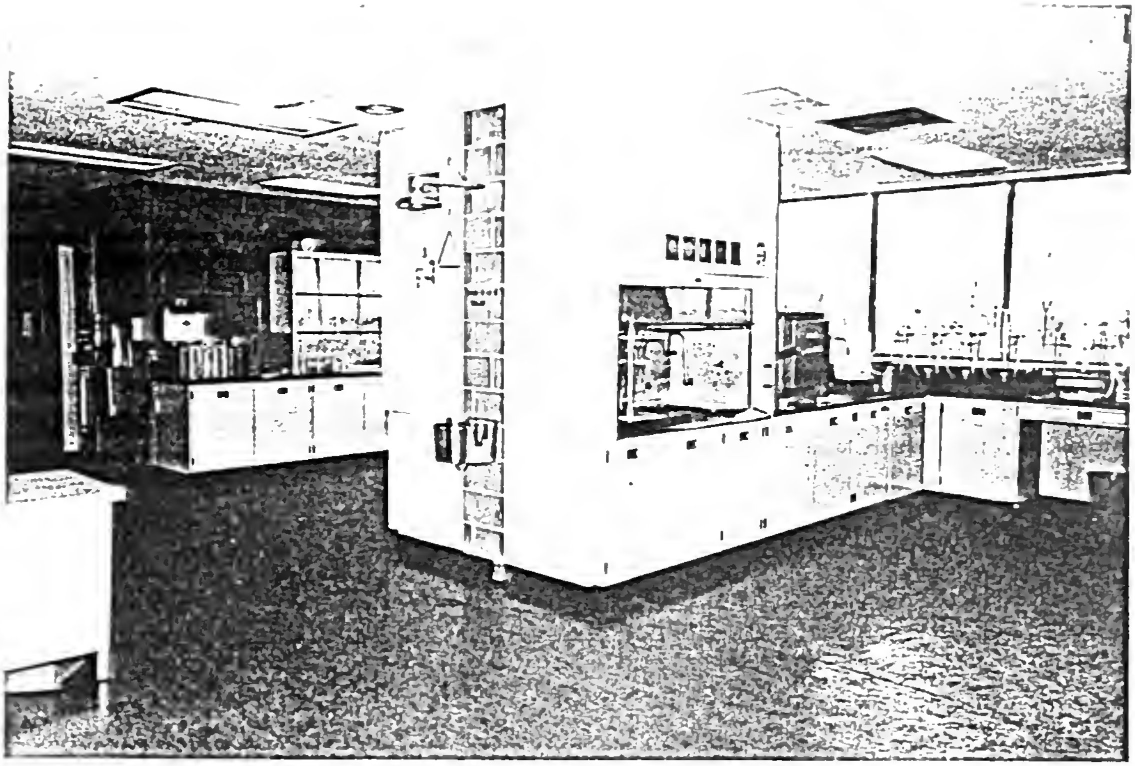
32. Aqua-Ammonia Day Tank on Scale



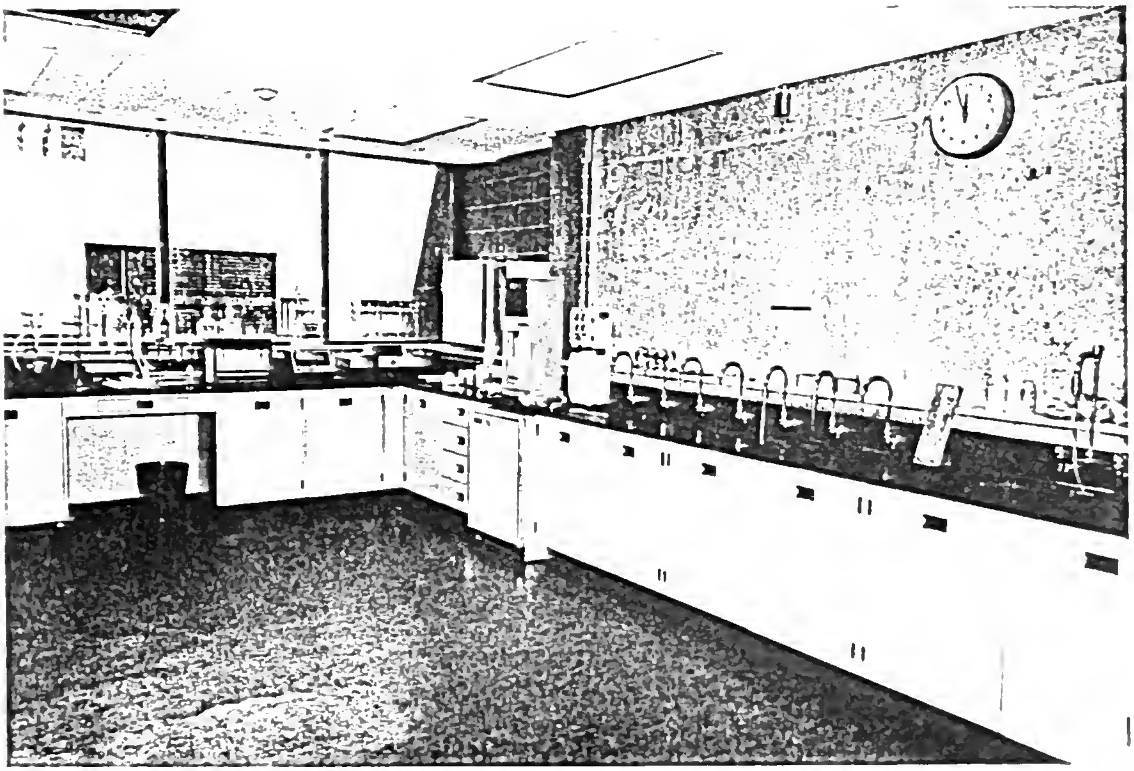
33. Hydrofluosilicic Acid Day Tanks on Scales and Metering Pumps



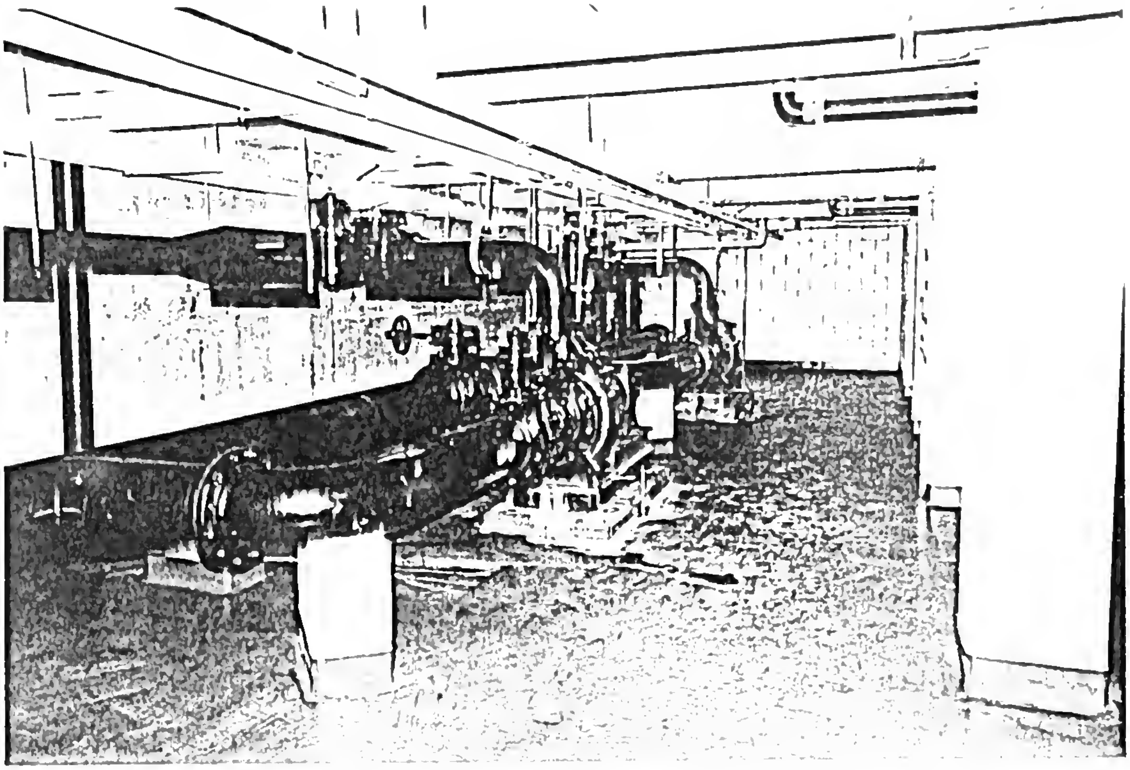
34. Operator Laboratory



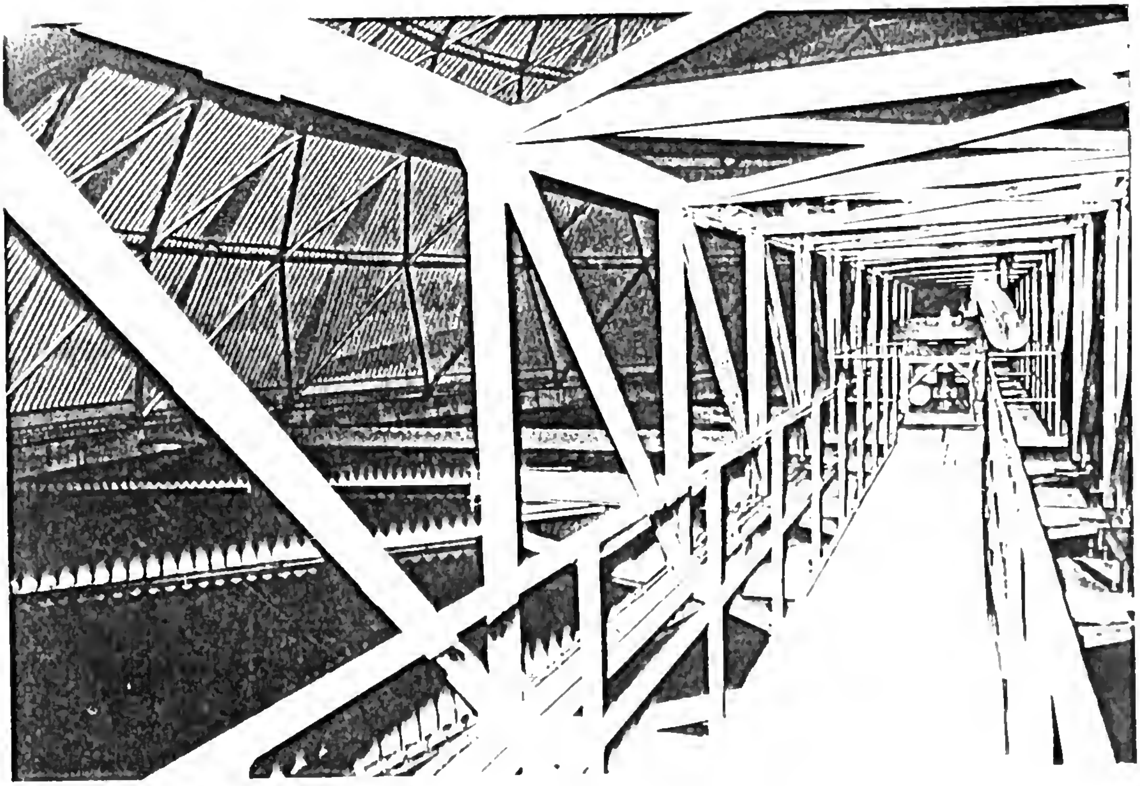
35. Main Laboratory



36. Main Laboratory



37. Waste Water Transfer Pumps



38. Waste Water Clarifier

# SECTION D

# PLANT OPERATION

# SECTION D - PLANT OPERATION

## D.1 GENERAL DESCRIPTION

### a) General

The Easterly Filtration Plant is one of four water treatment plants that is operated by Metro Works to supply potable water to the Metropolitan Toronto area and partially to the Region of York. The total population served by the Easterly plant and the per capita consumption are shown in Table 1.1 for 1984 to 1986.

The plant design is based on the direct filtration process for particulate removal comprising flash mixing, flocculation, and dual media gravity filtration. The flocculation process consists of two modules of mechanical flocculators, each module being divided into three cells in series for tapered flocculation, and two modules of innovative hydraulic in-line pipe flocculation designed to handle one-half of the plant flow. This is the first application of in-line pipe flocculation at a large treatment plant, and serves to prove whether it is feasible to use less costly treatment alternatives for the pretreatment of Lake Ontario water. Chemical treatment processes consist of coagulation, disinfection, control of taste and odour, fluoridation and ammoniation.

Waste water generated in the filter backwash water is treated in two solids-contact clarifiers for solids separation. The sludge is discharged to the Highland Creek Pollution Control Plant for further treatment and disposal.

### b) Operation

The plant is operated on a remote manual basis from the process controller. In case of emergencies, the plant can be operated on a local manual basis from the local area control panels. In case the process controller fails the plant can be operated from the control room by means of a standby analogue control panel which includes

instrumentation for supervisory control and remote manual adjustment of chemical dosages. In this mode a roving plant operator assists the filter plant operator (FPO) in locally starting and stopping processing equipment as directed by the FPO. Filter operation is monitored at the analogue control panel and when necessary are backwashed manually by the roving operator using a portable filter backwash console.

Operating staff consists of the following:

- 1 Chief Works Supervisor
- 1 Works Supervisor Gr. 1
- 1 Clerk 2
- 5 Filter Plant Operator
- 5 Filter Plant Assistant 1
- 2 Filter Plant Assistant 2
- 2 Machinist
- 2 Plant Maintenance Man Gr. 1
- 3 Plant Maintenance Man Gr. 2
- 1 Plant Maintenance Man Gr. 2 (Instrument Technician)
- 2 Electric Maintenance Man Gr. 1
- 2 Electric Maintenance Man Gr. 2
- 2 Electronic Technician
- 1 Instrument Technician
- 3 Handyman Gr. 3
- 3 Labourer
- 1 Stockkeeper.

Laboratory facilities include the plant main laboratory and an operator laboratory fully equipped for water quality and monitoring purposes and to permit calibration checks to be carried out on the continuous automatic analyses systems. The plant lab is staffed by:

- 1 Chief Chemist
- 1 Chemist
- 2 Chemist Assistant Gr. 1.

The plant operates on the basis of 2-12 hour shifts per day, 7 days per week except for every second Monday and Thursday when 3-8 hour shifts are in effect. Maintenance staff work an 8 hour day shift while

secretarial staff and laboratory personnel work a 1-7 hour day shift from Mondays to Fridays. Two operators are on duty for each shift - the Filter Plant Operator (FPO) and Filter Plant Assistant (FPA). During the day shift this team is supported by the Chief Works Supervisor and the Works Supervisor Gr. 1.

The FPO runs the plant from the control room. The FPA is the roving operator who monitors plant operations, collects manual water samples for analysis in the lab, does taste tests, confirms accuracy of on-line monitors, receives chemicals, and makes physical changes to valves and equipment to attain the desired operating mode established by the FPO. All entries in the Process Control Log Sheet (daily log) are made by the FPO. This includes hourly recording of flows, chemicals used, results of on-line monitors and laboratory analyses. The Chief Chemist checks and assesses the validity of all entries.

## D.2 FLOW CONTROL

### a) Raw Water Pumps

Control of the raw water pumps is remote manual from the process controller based on:

1) level in raw water well,
2) level in treated water reservoir,
3) pumping rate established for treated water pumps.

In the event of a process controller outage, the new raw water pumps are started manually from the local control panel located at the high voltage distribution panel.

Pumps are stopped manually either through the process controller or from the local control panel. During an electrical fault or trip condition motors will shut-down automatically and a general alarm will be indicated and logged by the process controller.

The control of the motorized pump discharge valve is interlocked with its related raw water pump control circuit, so that the valve functions

as a combined stop-check throttle service. The rate of valve opening is controlled and set for 3 minutes. This function serves to eliminate hydraulic shocks associated with starting and stopping large pumps. The motorized valves can also be used for trim-throttling of the pumps. The effect of start-up surges is further minimized by bringing pumps on-line through the flocculation tanks.

b) <u>Filters</u>

Filters are operated on the principle of constant rate filtration. Flow through the plant is divided equally by all on-line filters.

Filter rate control can be by computer, automatic or manual.

In the computer mode the filter rate set point on individual process controllers is automatically adjusted by the process controller based on level in the prefiltered water conduit. Each filter rate control valve throttles individually so that the measured flow at the venturi matches the flow set point. The degree of throttling will depend upon the head loss build-up in each filter. A filter being ramped on line is accelerated at a constant rate. During this time, all other filter rate control valves will close slowly while maintaining an equal flow division and a constant level in the prefiltered water conduit.

Filters can be operated from the process controller by manually setting the flow rate set point for each filter.

Operations from the analogue control panel can be either manual or automatic through C-M-A loading stations - one for each filter bank has been provided. Filter operation is similar to that described above for the process controller.

For backwashing the filter rate control valve can be opened and closed manually through the mobile backwash control console.

c) <u>Treated Water Pumps</u>

Control of the treated water pumps and their discharge valves is either remote manual from central pumpage control or remote manual from the process controller at the plant. Treated water pumpage is selected on the basis of the system demand. Local/manual control of the pumps is available through push-button loading switches on the high voltage distribution panel. Pumps will trip out automatically based on low level in the treated water suction channel.

## D.3 DISINFECTION PRACTICES

Chlorine gas is used for disinfection and the control of taste and odour. The ordinary (or normal) method for disinfection consists of prechlorination of the raw water followed by postchlorination of filtered water. In the event of high bacterial contamination of the source water, as indicated by a high free ammonia content, filtered water is superchlorinated. In addition, superchlorination is applied as a precautionary measure when the filtered water effluent turbidity exceeds 0.5 NTU. The high chlorine dosage applied during superchlorination is also beneficial in eliminating adverse taste and odours that might be present in the water. Sulphur dioxide is used to dechlorinate treated water to a predetermined chlorine residual. Final chlorination is practiced as a variation of dechlorination to maintain a desired minimum chlorine residual in the plant output.

The final effluent from the reservoir is ammoniated to provide a long-lasting residual in the distribution system.

A condensed summary of the disinfection process is as follows:

<u>Prechlorination</u>

- application point: - Raw Water P.S. intake
- dosage: - 0.8 mg/L (manually set)
- control: - by computer based on chlorine residual for qualitative control and summated raw water flow for quanti-

tative control; this mode is not used due to inaccuracies in the chlorine residual variable

- normal operation is by computer in open-loop control mode where chlorinator is paced on flow and dosage is adjusted, when necessary, manually from the computer
- from analogue control panel (ACP) using C-M-A loading stations, if computer is out of operation; chlorinator automatically paced on summated raw water flow, dosage set manually from panel

- chlorine residual:
  - free chlorine residual in raw and filtered water monitored continuously by chlorine analyzers, A-1 and A-2
  - in computer mode, A-1 used as controller with set point biased by signal from A-2 (through PC)

<u>Postchlorination/Superchlorination</u>

<u>Ordinary Postchlorination</u>

- application point:
  - effluent of filtered water conduit
- dosage:
  - variable between 0.4 to 1.5 mg/L depending on chlorine demand - applied when:
    - · $NH_3$ <0.020 mg/L as N in raw water
    - · free $CL_2$ residual after filters is >0.20 mg/L
    - · turbidity in composite filtered water is <0.50 NTU
    - · no taste or odour detected in filtered water or output
- control:
  - normal control is by computer using the flow-proportional open-loop

control mode; chlorinator is paced relative to total filtered water flow

- compound-loop control is available but not used due to instability in chlorine residual measurement
- as backup to computer, by analogue control panel (ACP) using C-M-A controllers for

  1) flow-proportional control-remote manual dosage setting with auto pacing relative to total filtered water flow

  2) compound loop control available, but not used for reason given above

- chlorine residual:
  - minimum free chlorine residual maintained at 0.70 mg/L in postchlorinated sample (analyzer A-3)
  - free chlorine residual monitored by chlorine residual analyzer after post-$Cl_2$ (A-3), after post-$Cl_2$ plus 30 minutes (A-4), and reservoir outlet before $SO_2$ (A-5)
  - in computer mode A-3 used as controller for post-$Cl_2$ dosage, set point biased by signal from A-4 (through PC)
  - minimum chlorine residual in reservoir outlet (A-5) maintained at 0.4 mg/L
  - free chlorine residual in after $SO_2$ sample (A-6) is maintained at:
    - 0.45 to 0.55 mg/L from May to October
    - 0.55 to 0.65 mg/L from October to May

Superchlorination

- application point:
  - effluent of filtered water conduit (as for postchlorination)
- dosage:
  - 1.5 mg/L and higher depending upon level of free $NH_3$ in raw water
  - dosage is set at 2.0 mg/L for $NH_3$ between 0.02 and 0.05 mg/L and increased by 1.0 mg/L for each 0.1 mg/L $NH_3$ level above 0.05 mg/L
  - 3.0 mg/L applied for control of chlorophenol tastes
- control:
  - by computer, superchlorination will initiate automatically if the free chlorine residual in filtered water is less than 0.20 mg/L for 10 minutes as measured by chlorine analyzer A-2
  - by ACP as for postchlorination, mode selection is done manually by operator
- chlorine residual:
  - minimum free chlorine residual maintained at 1.50 mg/L as measured by analyzer A-4 (after post-$Cl_2$ plus 30 minutes)
  - chlorine residual monitored in reservoir outlet (before $SO_2$) by analyzer A-5 and maintained at 1.2 mg/L minimum

Dechlorination

- application point:
  - in chemical mixing channel at outlet of reservoir using sulphur dioxide in solution form
- dosage:
  - $SO_2$ applied in amount equal to the excess residual chlorine.

| | |
|---|---|
| | - residual chlorine dosages in after $SO_2$ sample, analyzer A-6, maintained at levels indicated above for post-$Cl_2$ |
| - control: | - in auto mode through computer dechlorination is initiated by free chlorine residual signal in before $SO_2$ sample as measured by analyzer A-5 |
| | - dosage is determined and controlled by free chlorine residual in after $SO_2$ sample as measured by analyser A-6 and is paced relative to the summated plant output flow signal |
| | - in local/manual mode sulphonator is manually selected from ACP, dosage is pre-set on feeder and automatically paced relative to plant output flow |

Final Chlorination

| | |
|---|---|
| - applied: | - when free chlorine residual in before $SO_2$ sample is <0.4 mg/L |
| - application point: | - in chemical mixing channel at outlet of reservoir |
| - dosage: | - maintain total chlorine residual in output sample as measured by analyzer A-7 at 1.2 mg/L |
| - control: | - final chlorination can be initiated automatically by computer based on free chlorine residual signal in before $SO_2$ sample as measured by analyzer A-5 but is usually initiated remote manually from the computer |
| | - control by computer is flow-proportional based on the summated plant |

output flow signal and remote manual setting of the chlorine dosage

- in auto mode by computer (compound-loop control available but not used) qualitative control is obtained from analyzer A-6 and quantitative flow pacing is based on the summated plant output flow signal
- the set point for A-6 is manually adjustable through the PC
- from ACP using C-M-A controllers for auto compound-loop control or flow proportional control with remote manual setting of chlorine dosage

Ammoniation

- application point: - aqua ammonia solution is applied at the south end of the chemical mixing channel
- dosage: - $NH_3$ to free $Cl_2$ residual ratio of 1:3 is maintained, as measured in after $SO_2$ sample by analyzer A-6
- control: - dosage set manually through the PC and paced by summated plant output flow signal

In addition to using the free ammonia content in the raw water as an indicator for starting the superchlorination process, it is also used when:

1) chlorophenol tastes are present
2) filtered water turbidity is greater than 0.5 NTU.

In case the prechlorination system fails, the postchlorination dosage is increased to the combined pre- and postchlorine dosage.

An interruption in the postchlorination system will result in:

1) immediate shut down of filters, if interruption is of short duration
2) for long interruption, prechlorinators are used for postchlorination at a dosage recommended by the Chief Chemist.

## D.4 OPERATION OF SPECIFIC COMPONENTS

### D.4.1 Intake

No special operating procedures apply to the intake. No problems have been encountered. A plug can be positioned across the mouth of the intake shaft in order to isolate the intake from the raw water pumping station.

### D.4.2 Raw Water Pumps

Basically, raw water pumps are selected to match treated water flow; but the objective is to optimize the pumping rate over 24-hours. This is achieved by observing the level of the treated water reservoir and status of the treated water pumps when establishing raw water pumpage.

In selecting the pretreatment module to receive the flow, the raw water modulating valve will be interlocked with the appropriate pump discharge valve. The modulating valve will ramp open over a preset time to minimize hydraulic surges and serves to control the flow to the treatment process based on a manually selected flow rate set point. The valve ramping rate is set to match the rate of the filter rate controllers in order to maintain constant level in the pre-filtered water conduits.

Upon start-up of a raw water pump the increased flow is always passed through the flocculation tanks, modules 3 or 4, and if in use, flow is first transferred to modules 1 or 2. This transfer of flow is initiated manually at the process controller and executed automatically by the computer. The transfer is done manually in the event of a failure of the process controller.

### D.4.3 Flash Mixing

In-line blenders, one in each of the four pretreatment modules, are operated at constant speed on a continuous basis to flash mix chemical coagulant with the raw water. The blenders are operated remotely from the control room through the process controller. Local manual stop/start push-button controls are available at the motors for testing and local control.

The primary coagulant is injected at the blender through a six-point proportioning manifold. Polyelectrolyte as a coagulant aid can be injected downstream of the blender through a four-point proportioning manifold or upstream through a single point nozzle. Since September 1986 PACl has been applied via the single point injection nozzle.

### D.4.4 Flocculation

#### a) Mechanical Flocculation

Mechanical flocculators consist of axial flow vertical turbine mixers. These units are equipped with manually adjustable variable speed drives that will permit a wide selection of energy gradients from 20 $s^{-1}$ to 60 $s^{-1}$. The current settings for all flocculators are similar and provide a velocity gradient of 20 $s^{-1}$ in each cell.

Flocculators are normally started and stopped manually from the process controller. Stop/start push-buttons are available at the motor for local manual control. Status and alarm conditions are indicated at the computer.

#### b) In-Line Flocculation

In-line flocculators have no instrumentation; they are placed in service by the operation of the raw water modulating valves for modules 1 and 2. The plant operator manually selects the pretreatment module to be utilized and initiates the valve opening through the process controller. The rate of valve opening is controlled by a ramp generator; the ramp time is variable and can be set for 3 to 30

minutes. C-M-A controllers and C-M ramp generators are available at the ananogue control panel.

Modulating valves for modules 3 and 4, serving the mechanical flocculation tanks, are similar to those for modules 1 and 2 and are controlled in the same manner.

When increasing raw water flow, the raw water modulating valve will be ramped open at the same rate as the filtered water rate controllers in order to maintain constant level in the prefiltered water conduit.

### D.4.5 Filters

Filters are operated on the basis of constant rate filtration, control is automatic from the process controller based on the level of the prefiltered water conduit. Each rate control valve receives a common flow set point signal from the master rate controller; the valve in turn throttles individually so that the measured flow at the venturi matches the flow set point. The degree of throttling will depend upon the head loss build-up in each filter. With the process controller out of operation filters can be operated in either automatic or remote manual modes from the C-M-A loading station at the analogue control panel.

Filters are monitored for flow, head loss, level in the filter, and turbidity of the interface and effluent. Filter backwashing is done automatically through the process controller using a filter backwash program. The process controller will systematically take a filter out of service due to high head loss or high effluent turbidity. In the event that the process controller is out of service, the analogue control panel will receive the signal indicating that a given filter must be backwashed and the filter will be taken off line. Backwashing is then done by the operator using the mobile filter backwash control console which includes instrumentation for automatic and manual backwash modes.

The computerized backwash program automatically sequences the operation of motorized valves, backwash pumps and surface sweeps. The wash water

rate control valve modulates to achieve the desired flow rate set points for low rate (1 pump running) and high rate (3 pumps running). Pumps have unit capacities of about 1050 L/s at a rated head of 22.6 m. With three pumps running, a flow rate of about 3200 L/s is achieved at the operating head which is equivalent to a maximum rate of rise through the filter of 56.5 m/h (37 inches per minute). The duration of a filter wash is variable but normally does not exceed 15 minutes. The cycle is stopped automatically when the level of turbidity in the waste water reaches a preset limit of 40 NTU. An on-line turbidity meter, one for each bank of filters, senses turbidity in the waste water and provides the signal to the process controller. Following a filter wash, the filter is left to rest for 15 minutes before it is reinstated into service in order to let the filter settle down. Filter start-up is gradual by opening the rate control valve at a controlled ramped rate in order to minimize hydraulic surges and to reduce the initial high turbidity normally experienced at start-up.

The rate of flow acceleration through any filter on line due to an increase in raw water flow or a filter being taken off line for back-washing is done gradually at a controlled rate.

Backwashing operations are observed from time-to-time in order to detect potential problems such as "boiling" and mud-ball formation. Twice per year filters are checked for media loss and the anthracite coal is sampled for visual examination. Over the past 8 years 50 mm of media has been lost, which has been replenished.

### D.4.6 Clear Well

Each cell of the clear well is equipped with an 1850 mm diameter inlet sluice gate. These gates are equipped with automatic and remote manual controls for operation from the process controller or analogue control panel. In the constant rate filtration mode the gates are automatic-ally adjusted (in relation to flow rate) for maximum head loss without affecting filter performance in order to create turbulence for mixing of the postchlorine dosage prior to analysis.

In the declining rate filtration mode, which is an alternative to constant rate filtration, the circular sluice gates serve to automatically throttle the total filtered water flow in order to maintain a constant prefiltered water conduit level. The declining rate filtration mode has been provided for research purposes but has so far not been used.

The water level in the clear well is controlled by effluent discharge troughs which create a fixed storage volume with adequate contact time for postchlorination.

### D.4.7 Treated Water Reservoir

The reservoir is provided with a by-pass channel and equipped with 2740 mm by 2130 mm sluice gates one each on the inlet and by-pass, and three on the outlet. Flow discharges at low level to a chemical mixing channel and floods the backwash water suction well. The water level is allowed to fluctuate in the reservoir in order to make use of the available storage capacity for balancing of raw and treated water pumpage.

The chemical mixing channel downstream of the reservoir serves to provide contact time for final chemical addition (sulphur dioxide or chlorine and ammonia) and chemical residual monitoring. The mixing of chemicals into the flow is achieved with two large dual impeller, axial flow turbine mixers.

Flow from the mixing channel passes through the treated water suction channel to the pumps.

### D.4.8 Waste Water Treatment

The backwash water drains from the wash water conduit 1 and 2 into their respective waste water storage tanks (surge tanks). The tanks are interconnected by a 400 mm diameter pipe. An air mixing system in each tank is available to maintain solids in suspension. Waste water from the storage tanks is pumped on a continuous basis to the clarifiers through a 400 to 600 mm diameter discharge header. An

in-line blender has been installed in the 600 mm diameter pipe header in the pipe gallery near the clarifiers where alum and polyelectrolyte may be added. The flow to the clarifiers is divided equally by means of flow meters on the 450 mm diameter sections of the 600 mm diameter inlet pipes.

The clarifiers are of the solids-contact type and include a conical baffled flocculation-reaction zone. Settled sludge is recirculated and mixed with the influent flow in the flocculation zone. The conditioned waste water then enters the clarification zone where solids separation occurs. The thickened sludge is mchanically moved to a central discharge hopper and blown down intermittently to the sludge holding tank through a pneumatically operated sludge blowdown valve. The sludge is then pumped to the Highland Creek Pollution Control Plant while the supernatant from the clarifiers overflows radial collector troughs and is discharged by way of a 760 mm diameter storm sewer to a creek in the planned East Point Park.

The process controller has been programmed to control the operation of the waste water treatment system. Waste water transfer pumps are controlled on level in the storage tanks, while the rate of flow is controlled by the computer. A 400 mm diameter throttling valve in the pump discharge header is used for adjusting the rate of flow to the clarifiers.

The clarifiers are operated by starting and stopping equipment locally, but the status of the clarifiers is monitored by the process controller.

The sludge blowdown from the clarifiers to the holding tank is timer controlled. The sludge transfer pumps and discharge point can be controlled by the operator at the Highland Creek P.C.P. but pumps are operated automatically on level in the holding tank. The transfer pumps automatically stop on low level in the tank. The process controller can monitor the status of the system.

# D.5 CHEMICALS

## D.5.1 CONTROL OF CHEMICAL DOSAGES

### a) Alum

Liquid alum was the coagulant used at the plant. In mid-September 1986 the plant commenced using polyaluminum chloride (PACl) as the coagulant chemical.

The liquid alum coagulant was used at full commercial strength and was applied by individual chemical metering pumps for each pretreatment module.

The applied alum dosage was selected on the basis of the quality of the raw and filtered water. Relative to raw water turbidity the dosage guide used was as follows:

| Raw Turbidity NTU | Alum Dosage mg/L |
|---|---|
| 0 - 5 | 3 |
| 6 - 10 | 5 |
| 11 - 20 | 7 |
| 21 - 50 | 10 |

The dosage is increased to the next higher setting when the composite filtered water turbidity is greater than 0.5 NTU. Further increases are made if the filtered water turbidity does not come below 0.5 NTU following the duration of the detention time plus one hour. An adjustment in alum dosage to the next higher level is also made when the plankton count in the treated water exceeds 20 A.S.U. per ml.

The actual alum dosage applied is calculated daily using the total raw water flow treated and the volume in litres of liquid alum consumed. Alum consumption is calculated from level measurements in the bulk storage tank. The concentration of the bulk alum solution was confirmed in the lab.

b) Polyaluminum Chloride

Polyaluminum chloride is stored at full commercial strength in bulk fiberglass reinforced plastic solution storage tanks. Individual chemical metering pumps are used to feed the chemical coagulant to the in-line blenders of each pretreatment module for coagulation of the raw water.

As for alum, the applied dosage is selected on the basis of the quality of the raw and filtered water. An experimental dosage guide for PACl relative to raw water turbidity, which considers raw water pH and temperature also, is being used. Typical dosages for 1986 are as follows:

| Raw Turbidity NTU | PACl Dosage mg/L |
|---|---|
| 0.5 to 2.5 | 0.6 to 1.0 |

Generally, changes in the PACl dosages are made in accordance with the guidelines that have been established for alum. The applied dosages, however, are less than one-third of those required for alum.

A check on the chemical consumption is made daily by comparing the change in volume in the PACl storage tank with the calculated consumption based on dosage applied and quantity of water treated.

c) Chlorine and Sulphur Dioxide

As described previously, chlorine gas is used for disinfection and taste and odour control. Basically, the water flowing through the plant is prechlorinated, postchlorinated or superchlorinated, and trim-chlorinated, if required, to maintain the desired chlorine residual in the plant output.

The pre-chlorine dosage is set manually at 0.8 mg/L and has been chosen with the objective of minimizing THM formation. Experience has proven this dosage to be sufficient to achieve a free chlorine residual after the filters of ≤0.50 mg/L.

The post-chlorine dosage can vary from 0.4 to 1.5 mg/L and higher depending upon raw water quality. For postchlorination the objective is to maintain a minimum free chlorine residual in the post-chlorinated sample of 0.70 mg/L (analyzer A-3). At the reservoir outlet the objective is to maintain a minimum chlorine residual of 0.40 mg/L (analyzer A-5); while the free chlorine residual in the after sulphur dioxide addition sample is maintained at 0.45 - 0.55 mg/L between May 1 to November 1 and 0.55 - 0.65 mg/L between November 1 to May 1. The higher residual for the winter period is maintained to safeguard against higher bacterial densities in the lake water during that time.

For superchlorination the minimum free chlorine residual in the after post-chlorine plus 30-minutes sample is kept at 1.5 mg/L (analyzer A-4) and in the reservoir outlet sample (before dechlorination) at 1.2 mg/L (analyzer 5).

Dechlorination is achieved with sulphur dioxide. The applied dosage is set on the basis of maintaining the free chlorine residuals indicated above for postchlorination treatment.

Actual chlorine and sulphur dioxide dosages applied are calculated hourly from the weight of gas used and the amount of water treated.

Seven on-line chlorine residual analyzers monitor the chlorine residuals of:

| Service | Analyzer | Chlorine Residual |
|---|---|---|
| Raw Water | A-1 | total |
| Filtered Water | A-2 | free |
| After Post-$Cl_2$ | A-3 | free |
| After Post-$Cl_2$ plus 30 minutes | A-4 | free |
| Before - $SO_2$ | A-5 | free |
| After - $SO_2$ | A-6 | free |
| Plant Output | A-7 | total |

Several of the analyzers were provided for compound-loop control of chlorinators and sulphonators as previously described.

The accuracy of analyzers is carefully maintained by calibrating machines each shift and when a reading is suspect. The standard Wallace and Tiernan titrator is used to determine an accurate chlorine residual for comparison with the result from the auto analyzer. The accepted margin of error is less than 0.1 mg/L for a value of 0 to 1.0 mg/L chlorine and less than 0.2 mg/L for a value of 0 to 5.0 mg/L chlorine.

Chlorine consumption along with the equivalent dosage rates are logged hourly, daily and monthly for each chlorination service, pre-, post-, and final chlorination. A check on available inventory is made hourly through the process controller.

d) Ammonia

Aqua ammonia is used for ammoniation of the final plant output.

An ammonia dosage of 0.14 to 0.19 mg/L is normally applied for ammoniation. This dosage represents an ammonia-chlorine ratio of 1:3 which has been established by experience to be the optimum ratio.

A confirmation of the actual dosage applied is made hourly using the weight of ammonia consumed and the plant output flow rate. The hourly loss of weight in the day tanks on the scales is obtained from the computer. Data logging includes hourly, daily and monthly consumption and dosage rates. Control of available inventory is maintained by monitoring the level in the storage tanks.

e) Hydrofluosilicic Acid

The treated water is fluoridated with hydrofluosilicic acid. A dosage of 0.95 to 1.0 mg/L fluoride is applied.

Actual dosage is calculated every hour based on the actual weight of acid consumed and the amount of water treated as measured by the

filtered water flow signal. The hourly loss of weight in the day tanks on the scales is obtained from the computer. The amount of hydrofluosilicic acid on hand in storage tanks is recorded daily. Hourly consumption and calculated dosage rates are logged as are daily and monthly rates of consumption.

Confirmation of dosage is obtained from fluoride residual analyses results. Four hour spot samples and a daily composite sample (compiled hourly) are analyzed every day of the week. The samples are obtained from the plant output sample tap in the operator lab and analyzed in the main chemical laboratory.

As a precaution. the filter flow signal is checked against the summated total filtered flow. If the filter flow signal is ten per cent or higher greater than the actual, then fluoridation is discontinued by manually shutting down the fluoride pumps until the discrepancy has been rectified.

#### f) Sample Lines

All sample lines are backflushed at least once per week. Lines are back flushed independently from the operator lab and the chemical lab for 15 minutes.

## D.6 SAMPLING AND DATA COLLECTION

### D.6.1 PLANT RECORDS

The Easterly Filtration Plant is equipped with a computerized supervisory and control system. The process controller has been programmed to monitor all operating parameters required for normal day-to-day operations and for future trend analysis. Many parameters are monitored once a minute while other less critical parameters are monitored hourly and daily. The present status of all parameters may be requested at the process controller for display on the CRT. The values shown will be the last readings taken prior to the request.

Printed reports are produced at the end of each day indicating all logged data, and at the end of each month summarizing the monthly maximum, minimum and average values. Unfortunately, the computerized data acquisition system is not used for the plant's formal records due to field instrumentation inaccuracies.

Manual records kept by the plant to monitor plant operations include the following:

1) The Daily Process Control Log Sheet
2) The Daily Summary Record by Month
3) The Monthly Summary Record by Year.

An example of the daily log sheet is given in Appendix A of this report. Information, documented for the three-year operating period for this plant optimization study, is presented in Appendix C, Tables 1.0 to 6.0 inclusive.

### D.6.2 PROCESS AND QUALITY CONTROL

The plant operator is responsible for maintaining the daily log sheet. Data are recorded for every hour of the 24-hour day and includes information on flows, chemical treatment and quality control testing. At the end of the day the information is summarized and daily maximum, minimum and average values are recorded. Specific entries of the daily log sheet include the following:

a) Flows

- raw water flow to pretreatment modules
- total filtered water flow
- backwash water flow
- plant output - as measured by the plant meters and revenue meters.

b) Chemical Treatment

- liquid alum or · consumption in L/h and calculated maximum and minimum dosage

| | |
|---|---|
| - chlorine | · consumption in kg/h for prechlorination, post-chloriation, superchlorination and final chlorination including calculated maximum and minimum dosages<br>· weight is obtained from loss of weight scale transmitters |
| - sulphur dioxide | · consumption in kg/h from loss of weight scale transmitter<br>· calculated maximum dosage |
| - aqua-ammonia | · consumption in kg/h from loss of weight scale transmitter<br>· calculated maximum and minimum dosage |
| - fluoride | · hydrofluosilicic acid consumption, kg/h, from loss of weight scale transmitter<br>· calculated average dosage based on commercial concentration of acid (26%) and actual concentration determined in the lab. |

c) <u>Quality Control Testing</u>

| | |
|---|---|
| - chlorine residuals | · chlorine residuals from on-line monitors are recorded hourly in mg/L for: 1) raw water after chlorination, 2) filtered water, 3) after postchlorination, 4) before dechlorination, 5) after dechlorination, 6) plant output |
| - free ammonia | · samples analyzed manually in lab:<br>1) raw and filtered water - every 2 hours<br>· 2) before $SO_2$ and plant output - 3 times per day |
| - temperature | · raw water from temperature sensor transmitter |

| | | |
|---|---|---|
| - pH | · | pH is recorded based on auto analyzer transmitter for raw, prefiltered, after post-$Cl_2$, and output water |
| - turbidity | · | 1) raw water, 2) filtered water (composite), 3) plant output |
| | · | based on on-line turbidity meters |
| - taste and odour | · | hourly test done by operator on filtered water and plant output for: 1) chlorophenol, 2) earthy, 3) foul, and 4) weedy |
| - fluoride | · | raw water analyzed twice weekly, plant output six times per day plus one daily composite sample. |

## D.6.3 WATER QUALITY EXAMINATION

The plant laboratory performs daily routine analyses for various chemical, biological and bacteriological parameters. Results are recorded on the Daily and Monthly Record Sheets. A list of tests performed and the frequency of testing is given in Table D.1 to D.4.

## D.6.4 LABORATORY EQUIPMENT

The operator lab is equipped with one Wallace and Tiernan titrator, one turbidimeter - Hach Model 2100A, one Hach Model pH meter, one Lovibond colour comparitor, and one reflux distillation apparatus for ammonia distillation.

The following equipment is available at the main plant laboratory.

Chemical Lab

- 1 Colour Comparitor
- 1 Dynac II Centrifuge
- 1 SP 6-550 Spectrophotometer - Pye Unicam
- 1 Orion Research Microprocessor Ionalyzer/901

# TABLE D.1

## BACTERIOLOGICAL EXAMINATION

### A. TESTS PERFORMED

| Test | Water Sample | Method |
|---|---|---|
| Standard Plate Count and Total Coliform | Raw Water<br>Prefiltered Water<br>Individual Filters<br>Filter Composite<br>Plant Output | Millipore Filter |
| Fecal Coliform and Fecal Streptococcus | Raw Water<br>Plant Output | Millipore Filter |

### B. SAMPLING FREQUENCY

| Day of Week | Raw Water | Prefiltered Water | Filtered Water | Filtered Composite | Plant Output |
|---|---|---|---|---|---|
| Monday through Thursday | 4 per day | 4 per day | 2 per day | 1 per day | 6 per day |
| Friday | 3 per day | 4 per day | 2 per day | 1 per day | 6 per day |
| Saturday, Sunday and Holidays | 2 per day | 2 per day | - | - | 6 per day |

Notes:

1. Raw water samples are collected from the discharge of the raw water sample pump in the raw water pumping station. Sampling done by plant operator except for 2 samples on monday to thursday and 1 sample on friday collected by lab staff.

2. Prefiltered water samples are collected from the prefiltered water sample tap in the operator lab by the operator.

3. Filtered water samples are collected from individual filters by the lab staff.

   Filtered composite samples are collected in chemical lab by lab staff.

4. Plant output samples are collected from the output sample tap in the operator lab by the operator.

## TABLE D.2

## BIOLOGICAL EXAMINATION

| Test | Water Sample | Frequency | Method |
|---|---|---|---|
| Plankton - Identification & Enumeration | Raw Water | 1 per week | Concentration by Filtration |
| | Prefiltered Water | 1 per week | |
| | Plant Output | 1 per week | Identification & Counting by Microscope |

TABLE D.3

CHEMICIAL EXAMINATION - DAILY RECORD

| Parameter | Water Sampled | Frequency | Method |
|---|---|---|---|
| Turbidity | Raw, Filtered & Output | every hour | On-line Meter |
| pH | Raw<br>Output | every 2 hours<br>1 per day | On-line Meter |
| Colour | Raw, Prefiltered & Output | 1 per day | APHA - Colour Comparitor |
| Temperature | Raw | every 2 hours | On-line Meter |
| Taste & Odour | Filtered & Output | every hour | Operator |
| Free Ammonia-N | Raw & Filtered | every 2 hours | Nesslerization with Distillation |
| | Before $SO_2$ & Output | 3 per day | |
| COD | Raw, Prefiltered Output | 1 per week | COD Reflux Method |
| Chlorine Residual | Filtered, After Post, Before $SO_2$, After $SO_2$, and Output | every hour | On-line Chlorine Analyzer |
| Fluoride | Raw | 2 per week | Microprocessor/ Analyzer |
| | Output | Composite of 24 hourly samples & spot samples every 4 hours | |
| Phenol | Raw | 6 per week | Chloroform Extraction and by Spectrophotometer |
| | Output | 1 per week | |
| Aluminum | Raw | 1 per month | Spectrophotometer |
| | Output | 1 per day | |

TABLE D.3 (cont'd)

Notes:

1. Samples are collected from sample taps in operator lab. Periodically samples are taken at the source.

2. Turbidity results are checked once per shift, or more often, against lab result using Hach 2100A turbidity meter.

3. Chlorine residual results are checked once per shift, and when reading is suspect, against lab result using W & T titrator.

4. pH results are checked twice per week against lab result using Fisher Accumet pH meter.

5. Methods are based on Standard Methods for the Examination of Water and Wastewater.

TABLE D.4

CHEMICIAL EXAMINATION - MONTHLY RECORD

| Parameter | Water Sampled | Frequency | Method |
|---|---|---|---|
| Alkalinity | Raw, Prefiltered, Output | monthly | Titration with Sulphuric Acid |
| Cadmium | Raw Output | monthly | Spectrophotometer |
| Calcium | Raw, Output | monthly | Spectrophotometer |
| Chloride | Raw, Output | monthly | Titration with Silver Nitrate |
| Chromium | Raw, Output | monthly | Spectrophotometer |
| Carbon Dioxide | Output | 2 per year | Nomograph |
| Copper | Raw, Output | monthly | Spectrophotometer |
| Hardness | Raw, Output | monthly | EDTA Titration |
| Iron | Raw, Prefiltered, Output | monthly | Spectrophotometer |
| Lead | Raw, Output | monthly | Spectrophotometer |
| Magnesium | Raw, Output | monthly | Spectrophotometer |
| Manganese | Raw, Output | monthly | Spectrophotometer |
| Nitrate-N | Raw, Prefiltered, Output | monthly | Reduction Process |
| Organic Nitrogen | Raw, Output | monthly | Kjeldahl Method |
| Biochemical Oxygen Demand | Raw | monthly | BOD Test |
| Dissolved Oxygen | Raw, Output | monthly | Titration |
| Total Organic Carbon | Raw, Output | monthly | Combustion-Infra-red Method |
| Total Phosphate | Raw | monthly | Stannous Chloride Method |
| Potassium | Raw, Output | monthly | Spectrophotometer |
| Sodium | Raw, Output | monthly | Spectrophotometer |

TABLE D.4 (cont'd)

| Parameter | Water Sampled | Frequency | Method |
|---|---|---|---|
| Specific Conductance | Raw, Output | monthly | Conductivity Cell |
| Silica | Raw, Output | bi-monthly | Colourometric Method |
| Sulphate | Raw, Output | bi-monthly | Turbidimetric Method |
| Total Suspended Solids | Output | 2 per year | Evaporaton at 103-105°C |
| | Clarifier Sludge | monthly | |
| Volatile solids | Clarifier Sludge | monthly | Residue for Total Suspended Solids Ignited at 550°C |
| Zinc | Raw, Output | monthly | AA Spectrophotometer |

Note:

All analytical procedures are based on Standard Methods for the Examination of Water and Wastewater.

- 1 Hach Model 2100A Turbidimeter
- 1 Fisher Acumet pH Meter Model 630
- 1 Titration Cabinet
- 1 Reflux Condenser Apparatus
- 1 Kjeltec System 1002 Distilling Unit
- 1 Distillation Apparatus
- 1 Dedicated Fume Hood for Phenol Extraction
- 1 Fume Hood - General Work
- 1 Fisher Isotemp Model 350 Drying Oven
- 1 Sybron/Thermolyne Muffle Furnace
- 1 AA Spectrophotometer - Varian 475 Series
- 1 Carbon Rod Atomizer - Varian
- 1 Sartorius 2003 MPI Balance
- 1 Precisa 300C-3000D Balance

Microbiology Lab

- 1 Hot Air Sterilizer by Precision-Freas
- 2 Steam Sterilizers by Amsco Medallion
- 1 Reach-In Refrigerator
- 1 Programmable Incubator by SIS
- 1 Barnstead Distilling Apparatus
- 1 Sybron-Barnstead Deionizer
- 1 Moffatt Counter Mounted Hot Plate
- 1 Millipore UV Sterilizer
- 1 Millipore Incubator
- 1 Olympus Stereo-Miscoscope, 22X
- 1 Olympus BH Microscope, 400X
- 1 Colony Counter by American Optical

## D.7 PROCESS AUTOMATION

Reference is made to Section C.6 for a description of the available automated equipment. The computer-based monitoring and control system will permit complete automatic operation of the plant. However, in view of inaccuracies that exist in currently available field instrumentation, the plant is operated in a semi-automatic mode from the process controller.

Reference is made to previous sections of this report for a detail description of the operation of individual processing units.

## D.8 DAILY OPERATOR DUTIES

The filter plant operator is stationed in the control room. He is responsible for running the plant and maintaining the daily log sheet. He will also record such events as:

- treatment upsets:
  - power failure
  - control failure
  - elevated turbidity in filtered water and/or output
  - unsatisfactory residuals
- equipment outage:
  - major pumps
  - sampling pumps
  - chemical feeders
  - analyzers
- unusual events:
  - heavy algae runs
  - icing
  - vandalism
  - others.

The filter plant assistant is responsible for the following activities:

- in general, check operation of all equipment - pumps, motorized valves, mixers, flocculators and drives, compressors, chemical feed systems, instrumentation and control equipment,
- observe operation of filters during backwashing,
- check and record storage tank levels each day at 24:00 hours,
- collect hourly data for process monitoring and control and run taste tests,
- collect water samples for analysis in plant lab,
- baskflush sample lines according to established schedule,
- confirm accuracy of on-line monitors - pH, turbidity, chlorine residual,

- check and prepare buffer solutions for chlorine analyzers,
- confirm flow rate accuracy of liquid chemical metering equipment,
- check instrumentation for gaseous chemical feed systems,
- confirm accuracy of process instrumentation transmitters by comparing local indicator read outs with transmitted signals in control room,
- receive chemical deliveries,
- carry out instructions to process changes,
- exercise mechanical standby equipment such as chemical feeders and sample pumps,
- record and inform FPO of any unusual events and malfunctions,
- respond to alarm conditions.

Lastly, a most important function of the FPA is to stay in constant communication with the FPO, the Metro Works filter control officer in case the FPO is disabled, and the laboratory staff - the Chief Chemist or Chemist.

# SECTION E

# PLANT PERFORMANCE

# SECTION E - PLANT PERFORMANCE

## E.1 GENERAL OVERVIEW

Plant operations and performance at the Metro Toronto Easterly Filtration Plant were discussed with the Chief Works Supervisor, the Chief Chemist, and the Water Plant Engineer. The Plant is operated in a semi-automatic mode from the process controller in the control room. Whereas pumps are selected on a remote manual basis, the filters are operated automatically at constant rate of filtration and are programmed for automatic backwashing based on high head loss in the filter or high effluent turbidity. Chemical feed systems are operated in a semi-automatic mode by quantitatively pacing chemical feeders with preset dosages relative to flow.

Treated water quality has consistently bettered the levels set out in the Ontario Drinking Water Objectives of 1983. The raw water source is influenced by sewage treatment plant outfalls and by non-point sources of bacteriological contamination. Maximum total coliform densities in the raw water in the order of 4,400 counts/100 mL have been recorded during the winter months in 1986. Control of the bacteriological quality of the treated water is thus a primary concern of the Water Quality Division at the plant. The plant operating record for the study period presented in Table 6.0 attests to the excellent record for treated water quality that has been achieved. All test results for fecal coliform and fecal streptoccus bacteria were negative.

Algae in the raw water are also of concern since, at high levels, they induce problems with the operation of the filters, and occasionally impart objectionable tastes and odours to the raw water. Through the use of chemical treatment, however, the plant has consistently produced an odourless and taste free water for distribution to the consumer.

## E.2 TURBIDITY

### E.2.1. EVALUATION OF PARTICULATE REMOVAL EFFICIENCY

#### a) Raw Water Quality

Operating records for particulate removal at the Easterly Filtration Plant are presented in Tables 2.0 and 2.1 of Appendix C. Table 2.0 presents a monthly summary of the average, maximum and minimum raw and treated water turbidity values for 1984 to 1986. In addition, corresponding values are tabulated for i) primary coagulant, ii) aluminum residual in the raw and treated water, iii) raw and treated water pH, and iv) raw water temperature. Daily values for the same parameters are presented in Table 2.1 for January, April, July and October for each of 1984 to 1986.

At the Easterly plant, particulate removal from the source water is achieved by direct filtration. The process is optimized by coagulation of raw water turbidity with alum in the flash mixers followed by mechanical and/or in-line flocculation prior to filtration. The objective is to produce the highest achievable water clarity in the finished water, equal to or less than 0.3 NTU turbidity, with the least amount of coagulant addition under any of the occurring raw water turbidity conditions.

Raw water is drawn through an intake crib that is 2,960 m offshore and located in 18 m of water; the depth of water above the crib is 12.3 m at average lake level. At this location good raw water quality exists throughout the entire year; although, based on bacteriological test data, it appears that sewage treatment plant discharges influence water quality somewhat. This will be evident from the summary of raw water characteristics presented in Table E.1. The average monthly turbidity levels for 1986 only varied from 0.82 to 1.8 FTU and the yearly average value was 1.16 FTU. Graphs for the monthly variations in turbidity, daily maximum, minimum and average values are shown in Figure E.1 for the three-year period of record. Higher levels of turbidity were experienced for short durations during spring storms and in the fall and winter. Monthly daily maximum values ranged from 1.2 to 8.2 FTU in 1984 to 1986.

TABLE E.1

LAKE ONTARIO RAW WATER CHARACTERISTICS IN 1986

(At the Toronto Easterly F.P. Intake)

| Month 1986 | Average Turbidity NTU | Algae Count ASU/mL | pH Units | Average Temperature °C | Average Total/Coliform Count/100 mL |
|---|---|---|---|---|---|
| January | 1.8 | 97 | 8.1 | 3.3 | 33 |
| February | 1.3 | 121 | 8.1 | 2.0 | 27 |
| March | 1.5 | 132 | 8.1 | 2.3 | 28 |
| April | 0.98 | 366 | 8.2 | 3.7 | 5.8 |
| May | 0.88 | 406 | 8.2 | 5.6 | 5.8 |
| June | 0.82 | 509 | 8.2 | 6.4 | 6.5 |
| July | 0.98 | 837 | 8.2 | 9.8 | 6.6 |
| August | 1.3 | 152 | 7.9 | 11.4 | 37 |
| September | 1.1 | 431 | 8.1 | 10.7 | 63 |
| October | 0.88 | 184 | 8.1 | 9.4 | 62 |
| November | 1.0 | 162 | 8.0 | 5.8 | 57 |
| December | 1.4 | 220 | 8.1 | 3.7 | 207 |

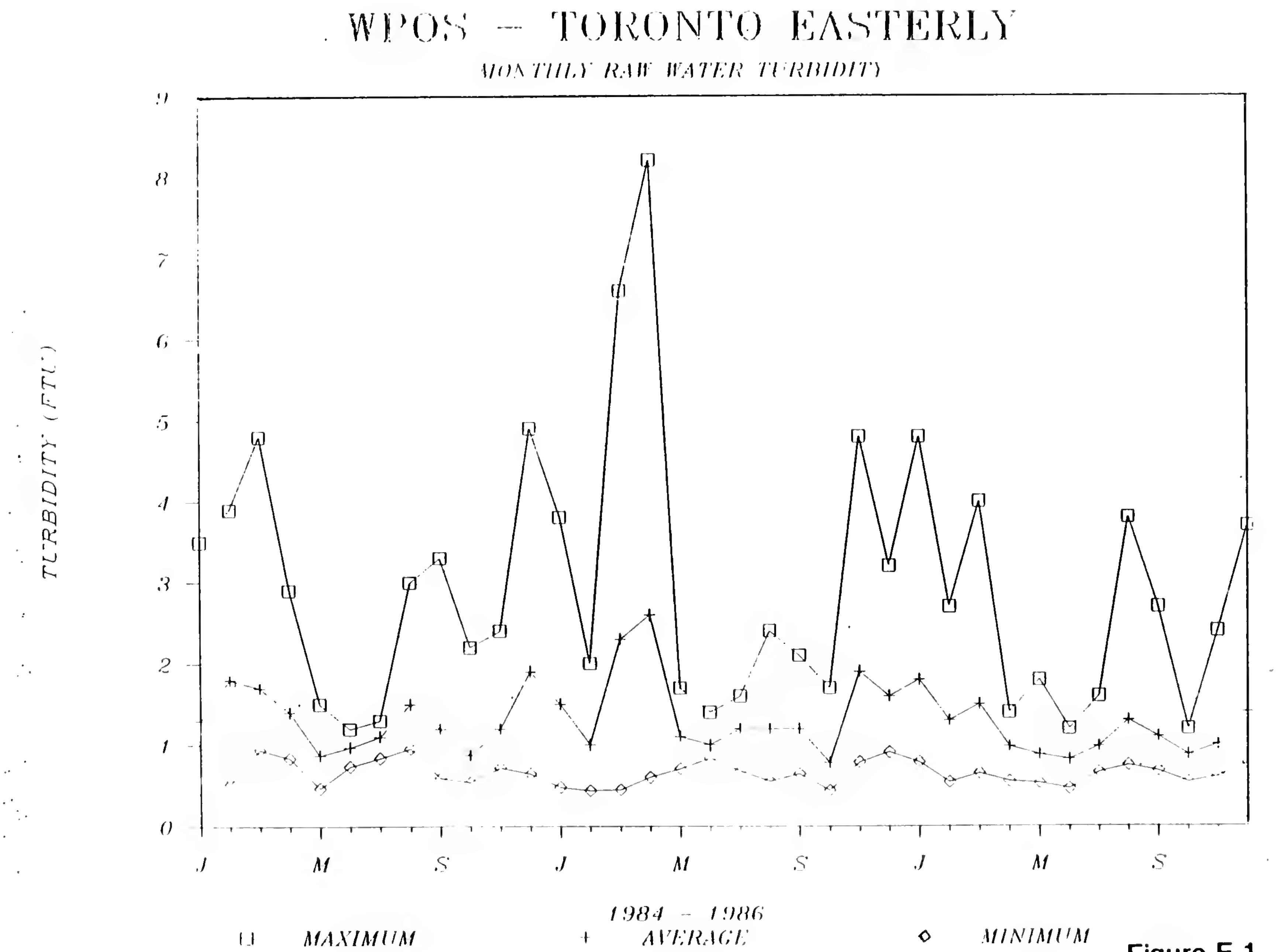

WPOS – TORONTO EASTERLY
MONTHLY RAW WATER TURBIDITY
TURBIDITY (FTU)
9
8
7
6
5
4
3
2
1
0
J
M
S
J
M
S
J
M
S
1984 – 1986
MAXIMUM
AVERAGE
MINIMUM

Figure E.1

In Figure E.2 turbidity frequency curves are presented for monthly maximum and average values. The curves illustrate the per cent of time a given value of turbidity within the data range was exceeded during the three year period of record. From the graphs it will be noted that average monthly turbidity is less than 2 NTU 95% of the time and less than 1 NTU 33% of the time. Daily maximum monthly turbidities are less than 5 NTU 95% of the time and less than 3 NTU 61% of the time.

An analysis of the durations of higher than average turbidity events was carried out. Table E.2 summarizes periods with above average turbidity levels. In reference to the data presented, it will be evident that the worst period occurred during the nine days of April 1985 when turbidity in the raw water varied from about 0.9 to 8.2 NTU and the daily average value was about 4 NTU.

These levels of turbidity, even though they can persist for about ten days at any one time, are relatively low and can be handled by the treatment plant without causing any significant impact on the quality of the treated effluent.

A greater variation in turbidity occurs on an hourly basis. This was evident from the plant record which documents the minimum and maximum values obtained from the hourly test results. For the three-year record hourly maximum turbidity levels ranged from about 2 to 20 NTU and are more than twice as high as daily maximum values. These fluctuations, although of short duration, can have an impact on treatment plant performance and require immediate operator response in adjusting the coagulant dosage.

Periods of high raw water turbidity events fortunately coincide with lower demand, as illustrated in Figure E.3, which tends to lessen the impact of higher than normal solids loadings on filter performance.

b) <u>Particulate Removal</u>

The removal of particulate matter is achieved by chemical coagulation and flocculation followed by filtration. Since February 1984, liquid alum was again used as the coagulant; in the two previous years ferric

chloride was used. In September 1986, the application of alum was discontinued in favour of polyaluminum chloride (PACl) which was introduced on an experimental basis. For this report the evaluation of particulate removal will be devoted to alum coagulation since the available data base for the alternate PACl coagulant is rather short.

The alum dosage was selected on the basis of a dosage guide and operating criteria presented previously in Section D.5.1. The actual operating dosage that was applied during the period of study is shown graphically in Figure E.4. Upper and lower boundaries define the band of alum applied for raw water turbidities varying from 0.4 to above 8 NTU. The range in the applied alum dosage varied somewhat, reflecting the dynamic characteristics of the raw water, but is consistent with the overall plant policy for dosage selection.

The overall treatment plant performance with regard to particulate removal was very good as is evident from the summary of the operating record presented in Table 2.0 of Appendix C, and the graphical illustration of these data presented in Figure E.5. On a monthly average basis, it will be noticed that the turbidity in the treated water ranged from 0.15 to 0.24 NTU in 1986, 0.16 to 0.27 NTU in 1985 and 0.11 to 0.28 NTU in 1984. The yearly average values for the three respective years were 0.19, 0.21 and 0.16 NTU.

Plant performance on a daily basis is presented in Table 2.1 of Appendix C for January, April, July and October for each of the three years studied.

Daily average treated water turbidities generally were in the order of 0.15 to 0.25 NTU, the minimum and maximum values recorded were 0.08 NTU and 0.36 NTU respectively.

For April 1984 effluent turbidities were consistently below 0.17 NTU; a minimum daily average of 0.08 NTU was recorded and the average for the month was 0.12 NTU. This was the best effluent turbidity achieved over the three year study period.

# TABLE E.2

## HIGHER THAN AVERAGE RAW WATER TURBIDITY EVENTS - 1984 TO 1986

| Date 1984 | Turbidity NTU | Date 1985 | Turbidity NTU | Date 1986 | Turbidity NTU |
|---|---|---|---|---|---|
| Feb. 13 | 0.84 | Mar. 1 | 2.2 | Jan. 24 | 0.82 |
| Feb. 14 | 4.0 | Mar. 2 | 4.9 | Jan. 25 | 4.8 |
| Feb. 15 | 5.6 | Mar. 3 | 3.0 | Jan. 26 | 2.1 |
| Feb. 16 | 2.3 | Mar. 4 | 4.1 | Jan. 27 | 2.1 |
| | | Mar. 5 | 3.5 | Jan. 28 | 1.5 |
| | | Mar. 6 | 1.7 | | |
| | | Mar. 7 | 6.6 | Mar. 19 | 0.98 |
| Dec. 19 | 0.79 | Mar. 8 | 1.0 | Mar. 20 | 4.0 |
| Dec. 20 | 1.3 | Mar. 9 | 0.5 | Mar. 21 | 3.3 |
| Dec. 21 | 3.1 | | | Mar. 22 | 2.0 |
| Dec. 22 | 4.9 | | | | |
| Dec. 23 | 2.7 | | | | |
| Dec. 24 | 2.0 | Mar. 31 | 2.7 | | |
| Dec. 25 | 1.6 | Apr. 1 | 5.7 | Aug. 27 | 0.82 |
| Dec. 26 | 1.5 | Apr. 2 | 3.3 | Aug. 28 | 2.8 |
| Dec. 27 | 4.6 | Apr. 3 | 0.9 | Aug. 29 | 3.8 |
| Dec. 28 | 2.6 | Apr. 4 | 2.0 | Aug. 30 | 3.6 |
| Dec. 29 | 1.6 | Apr. 5 | 2.8 | Aug. 31 | 1.5 |
| | | Apr. 6 | 4.0 | | |
| | | Apr. 7 | 6.2 | | |
| | | Apr. 8 | 8.2 | | |
| | | Apr. 9 | 4.3 | | |
| | | Apr. 10 | 1.5 | | |
| | | Nov. 15 | 1.1 | | |
| | | Nov. 16 | 2.6 | | |
| | | Nov. 17 | 4.8 | | |
| | | Nov. 18 | 2.5 | | |
| | | Nov. 19 | 2.6 | | |
| | | Nov. 20 | 2.2 | | |
| | | Nov. 21 | 1.2 | | |

# WPOS - TORONTO EASTERLY

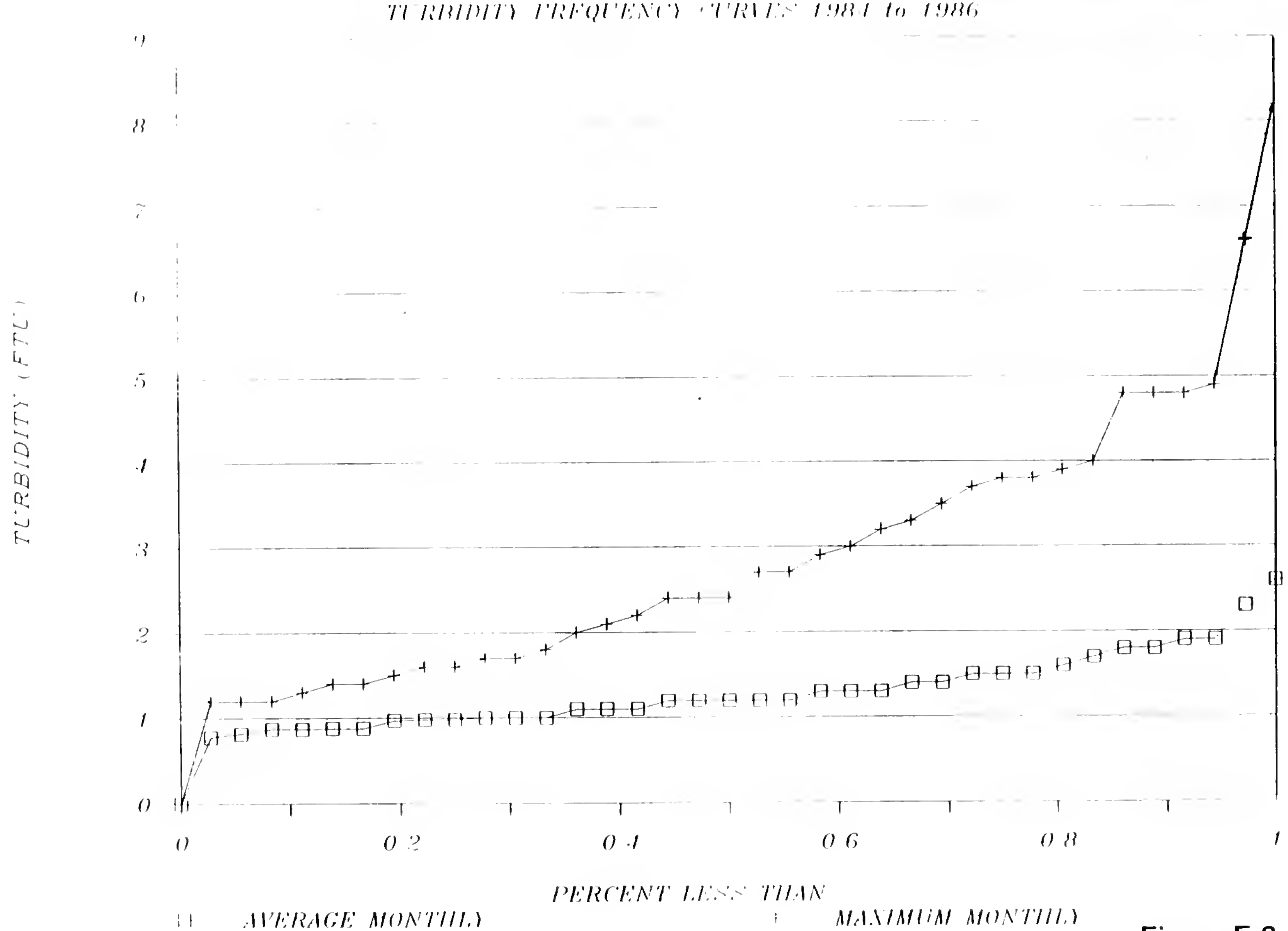



Figure E.2

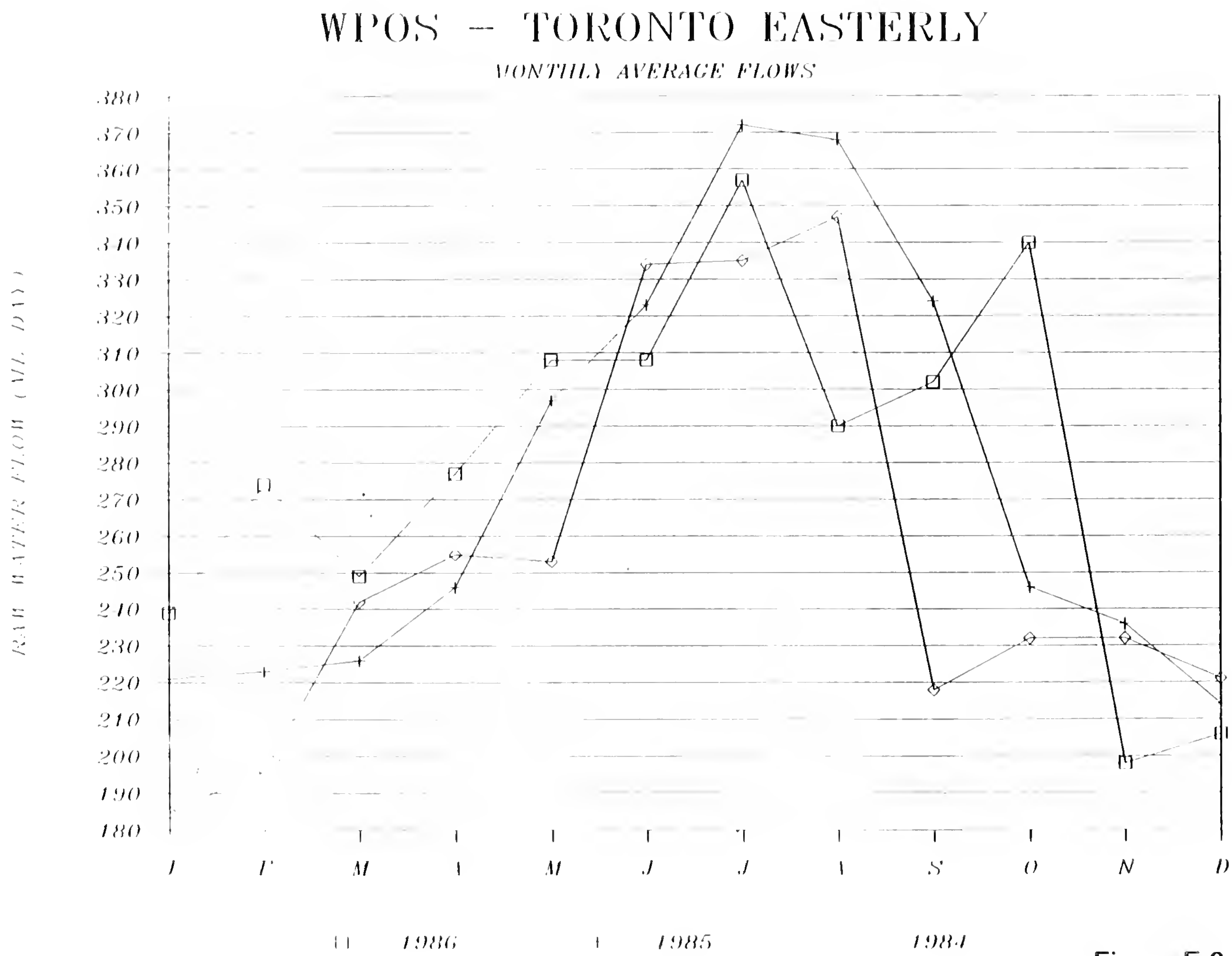

WPOS – TORONTO EASTERLY
MONTHLY AVERAGE FLOWS
RAW WATER FLOW (ML/DAY)
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
J F M A M J J A S O N D
1986
1985
1984

Figure E.3

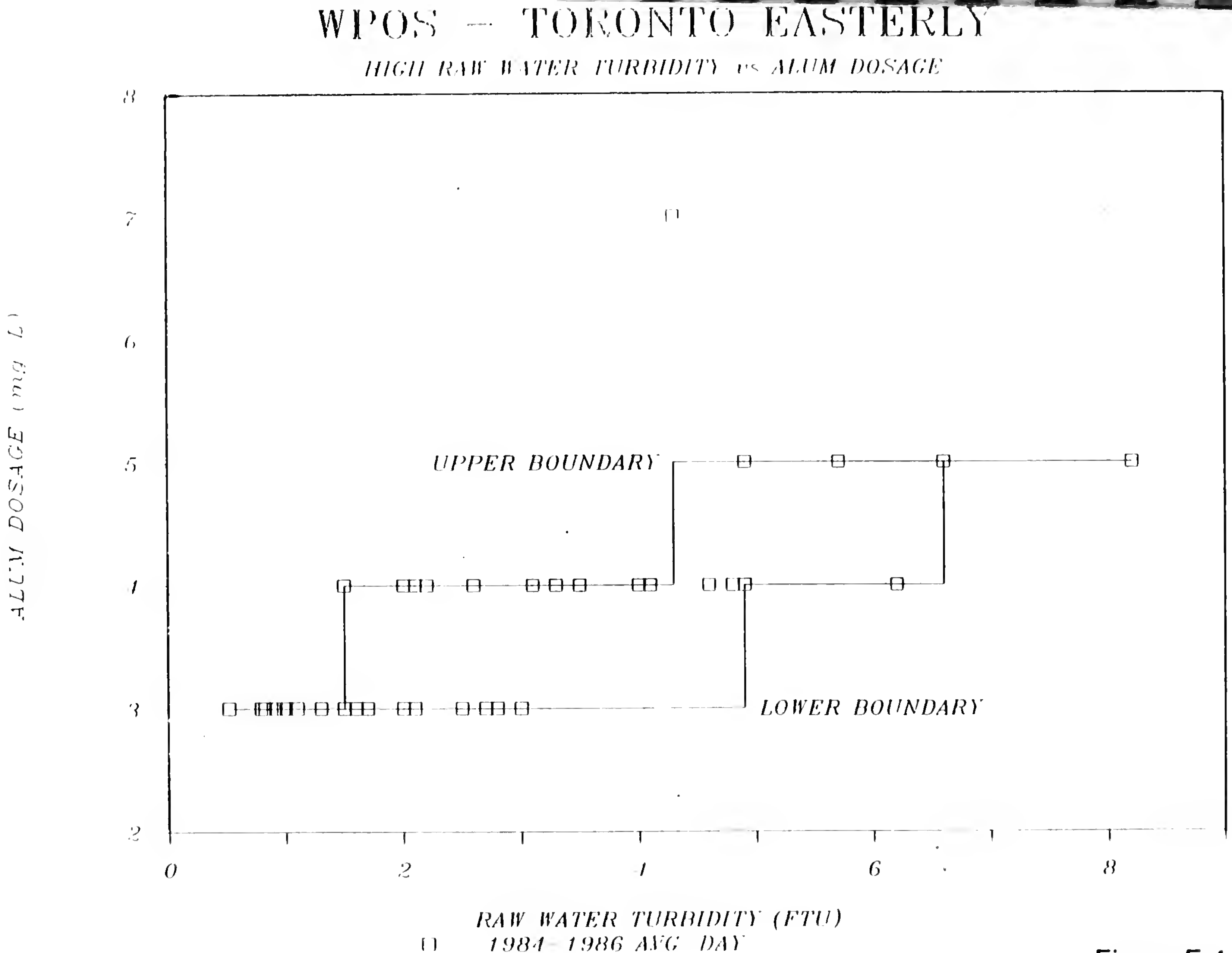

WPOS – TORONTO EASTERLY
HIGH RAW WATER TURBIDITY vs ALUM DOSAGE
ALUM DOSAGE (mg/L)
8
7
6
5
4
3
2
UPPER BOUNDARY
LOWER BOUNDARY
0
2
4
6
8
RAW WATER TURBIDITY (FTU)
1984–1986 AVG DAY

Figure E.4

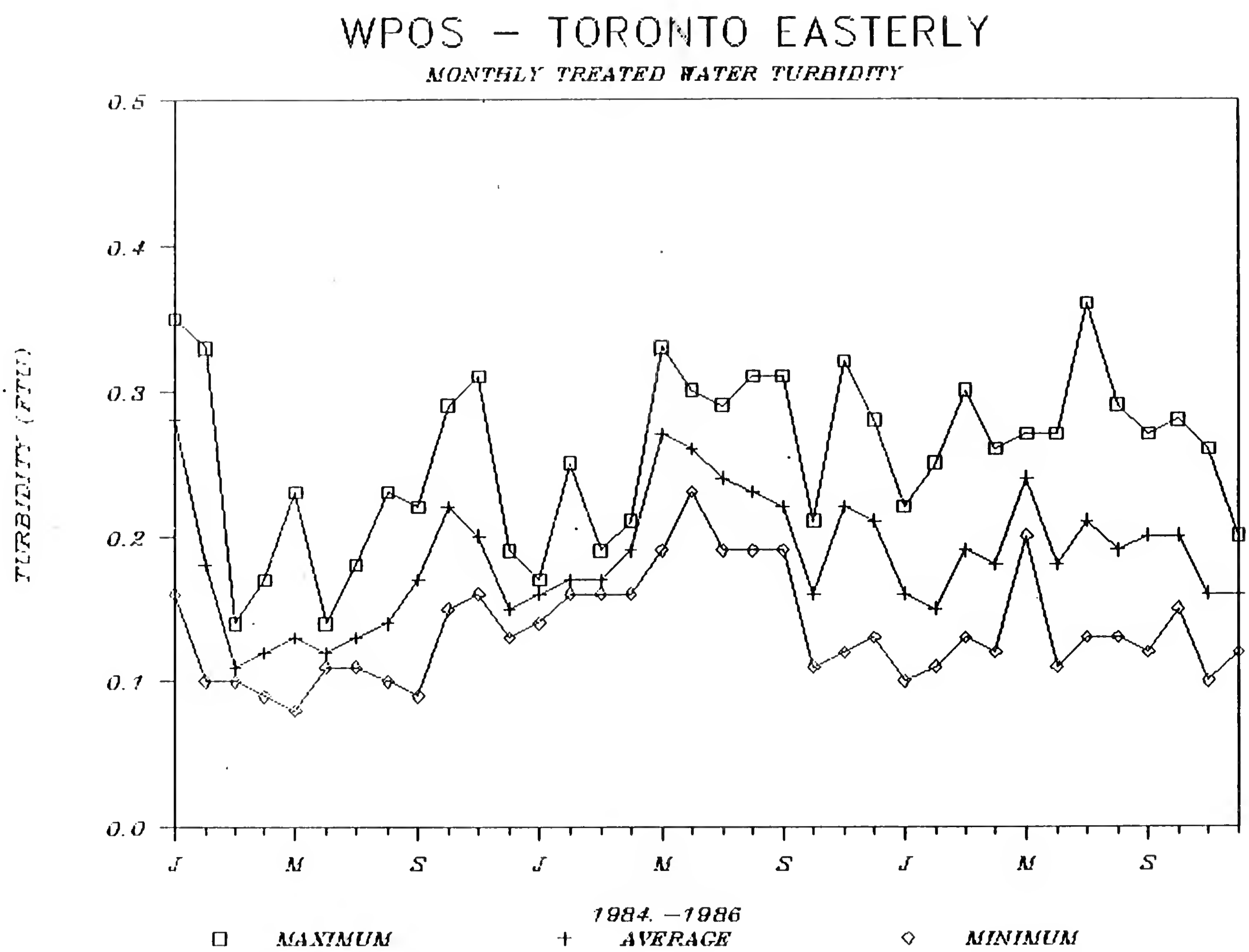

WPOS - TORONTO EASTERLY
MONTHLY TREATED WATER TURBIDITY
TURBIDITY (FTU)
0.5
0.4
0.3
0.2
0.1
0.0
J
M
S
J
M
S
J
M
S
1984 -1986
□ MAXIMUM
+ AVERAGE
◇ MINIMUM

Figure E.5

In Figure E.2 turbidity frequency curves are presented for monthly maximum and average values. The curves illustrate the per cent of time a given value of turbidity within the data range was exceeded during the three year period of record. From the graphs it will be noted that average monthly turbidity is less than 2 NTU 95% of the time and less than 1 NTU 33% of the time. Daily maximum monthly turbidities are less than 5 NTU 95% of the time and less than 3 NTU 61% of the time.

An analysis of the durations of higher than average turbidity events was carried out. Table E.2 summarizes periods with above average turbidity levels. In reference to the data presented, it will be evident that the worst period occurred during the nine days of April 1985 when turbidity in the raw water varied from about 0.9 to 8.2 NTU and the daily average value was about 4 NTU.

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b) Particulate Removal

The removal of particulate matter is achieved by chemical coagulation and flocculation followed by filtration. Since February 1984, liquid alum was again used as the coagulant; in the two previous years ferric

chloride was used. In September 1986, the application of alum was discontinued in favour of polyaluminum chloride (PACl) which was introduced on an experimental basis. For this report the evaluation of particulate removal will be devoted to alum coagulation since the available data base for the alternate PACl coagulant is rather short.

The alum dosage was selected on the basis of a dosage guide and operating criteria presented previously in Section D.5.1. The actual operating dosage that was applied during the period of study is shown graphically in Figure E.4. Upper and lower boundaries define the band of alum applied for raw water turbidities varying from 0.4 to above 8 NTU. The range in the applied alum dosage varied somewhat, reflecting the dynamic characteristics of the raw water, but is consistent with the overall plant policy for dosage selection.

The overall treatment plant performance with regard to particulate removal was very good as is evident from the summary of the operating record presented in Table 2.0 of Appendix C, and the graphical illustration of these data presented in Figure E.5. On a monthly average basis, it will be noticed that the turbidity in the treated water ranged from 0.15 to 0.24 NTU in 1986, 0.16 to 0.27 NTU in 1985 and 0.11 to 0.28 NTU in 1984. The yearly average values for the three respective years were 0.19, 0.21 and 0.16 NTU.

Plant performance on a daily basis is presented in Table 2.1 of Appendix C for January, April, July and October for each of the three years studied.

Daily average treated water turbidities generally were in the order of 0.15 to 0.25 NTU, the minimum and maximum values recorded were 0.08 NTU and 0.36 NTU respectively.

For April 1984 effluent turbidities were consistently below 0.17 NTU; a minimum daily average of 0.08 NTU was recorded and the average for the month was 0.12 NTU. This was the best effluent turbidity achieved over the three year study period.

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HIGHER THAN AVERAGE RAW WATER TURBIDITY EVENTS - 1984 TO 1986

| Date 1984 | Turbidity NTU | Date 1985 | Turbidity NTU | Date 1986 | Turbidity NTU |
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| Feb. 14 | 4.0 | Mar. 2 | 4.9 | Jan. 25 | 4.8 |
| Feb. 15 | 5.6 | Mar. 3 | 3.0 | Jan. 26 | 2.1 |
| Feb. 16 | 2.3 | Mar. 4 | 4.1 | Jan. 27 | 2.1 |
| | | Mar. 5 | 3.5 | Jan. 28 | 1.5 |
| | | Mar. 6 | 1.7 | | |
| | | Mar. 7 | 6.6 | Mar. 19 | 0.98 |
| Dec. 19 | 0.79 | Mar. 8 | 1.0 | Mar. 20 | 4.0 |
| Dec. 20 | 1.3 | Mar. 9 | 0.5 | Mar. 21 | 3.3 |
| Dec. 21 | 3.1 | | | Mar. 22 | 2.0 |
| Dec. 22 | 4.9 | | | | |
| Dec. 23 | 2.7 | | | | |
| Dec. 24 | 2.0 | Mar. 31 | 2.7 | | |
| Dec. 25 | 1.6 | Apr. 1 | 5.7 | Aug. 27 | 0.82 |
| Dec. 26 | 1.5 | Apr. 2 | 3.3 | Aug. 28 | 2.8 |
| Dec. 27 | 4.6 | Apr. 3 | 0.9 | Aug. 29 | 3.8 |
| Dec. 28 | 2.6 | Apr. 4 | 2.0 | Aug. 30 | 3.6 |
| Dec. 29 | 1.6 | Apr. 5 | 2.8 | Aug. 31 | 1.5 |
| | | Apr. 6 | 4.0 | | |
| | | Apr. 7 | 6.2 | | |
| | | Apr. 8 | 8.2 | | |
| | | Apr. 9 | 4.3 | | |
| | | Apr. 10 | 1.5 | | |
| | | Nov. 15 | 1.1 | | |
| | | Nov. 16 | 2.6 | | |
| | | Nov. 17 | 4.8 | | |
| | | Nov. 18 | 2.5 | | |
| | | Nov. 19 | 2.6 | | |
| | | Nov. 20 | 2.2 | | |
| | | Nov. 21 | 1.2 | | |

TABLE E.3

PLANT PERFORMANCE DURING PERIODS OF

HIGHER THAN AVERAGE RAW WATER TURBIDITY EVENTS - 1984 TO 1986

| | Date | Average Day Turbidity, NTU Raw | Filtered | Alum Dosage mg/L | Flow ML/d |
|---|---|---|---|---|---|
| 1984 | Feb. 13 | 0.84 | 0.31 | 2 (Fe) | 197 |
| | Feb. 14 | 4.0 | 0.19 | 4/3(1)(Fe) | 233 |
| | Feb. 15 | 5.6 | 0.14 | 4/3 (Fe) | 207 |
| | Feb. 16 | 2.3 | 0.12 | 3/2 (Fe) | 229 |
| | | | | | |
| | Dec. 19 | 0.79 | 0.11 | 3 | 190 |
| | Dec. 20 | 1.3 | 0.10 | 3 | 206 |
| | Dec. 21 | 3.1 | 0.09 | 5/3 | 223 |
| | Dec. 22 | 4.9 | 0.09 | 5/3 | 201 |
| | Dec. 23 | 2.7 | 0.11 | 3 | 211 |
| | Dec. 24 | 2.0 | 0.11 | 3 | 193 |
| | Dec. 25 | 1.6 | 0.12 | 3 | 189 |
| | Dec. 26 | 1.5 | 0.10 | 3 | 183 |
| | Dec. 27 | 4.6 | 0.10 | 5/3 | 199 |
| | Dec. 28 | 2.6 | 0.11 | 5/3 | 203 |
| | Dec. 29 | 1.6 | 0.13 | 3 | 197 |
| | | | | | |
| 1985 | Mar. 1 | 2.2 | 0.15 | 5/3 | 223 |
| | Mar. 2 | 4.9 | 0.19 | 5 | 295 |
| | Mar. 3 | 3.0 | 0.19 | 3 | 219 |
| | Mar. 4 | 4.1 | 0.16 | 5/3 | 207 |
| | Mar. 5 | 3.5 | 0.11 | 5/3 | 216 |
| | Mar. 6 | 1.7 | 0.10 | 3 | 230 |
| | Mar. 7 | 6.6 | 0.22 | 5 | 215 |
| | Mar. 8 | 1.0 | 0.15 | 3 | 194 |
| | Mar. 9 | 0.5 | 0.09 | 3 | 210 |
| | | | | | |
| | Mar. 31 | 2.7 | 0.10 | 3 | 215 |
| | Apr. 1 | 5.7 | 0.16 | 5 | 283 |
| | Apr. 2 | 3.3 | 0.11 | 5/3 | 226 |
| | Apr. 3 | 0.9 | 0.09 | 3 | 209 |
| | Apr. 4 | 2.0 | 0.09 | 3 | 206 |
| | Apr. 5 | 2.8 | 0.11 | 3 | 199 |
| | Apr. 6 | 4.0 | 0.11 | 5/3 | 199 |
| | Apr. 7 | 6.2 | 0.12 | 5/3 | 199 |
| | Apr. 8 | 8.2 | 0.14 | 5 | 209 |
| | Apr. 9 | 4.3 | 0.19 | 7 | 261 |
| | Apr. 10 | 1.5 | 0.28 | 5/3 | 334 |

Fe = $FeCl_3$

(1) Maximum/Minimum

| Date | Average Day Turbidity, NTU Raw. | Filtered | Alum Dosage mg/L | Flow ML/d |
|---|---|---|---|---|
| 1985 Nov. 15 | 1.1 | 0.16 | 3 | 259 |
| Nov. 16 | 2.6 | 0.15 | 5/3([1]) | 207 |
| Nov. 17 | 4.8 | 0.14 | 5/3 | 207 |
| Nov. 18 | 2.5 | 0.25 | 3 | 201 |
| Nov. 19 | 2.6 | 0.19 | 5/3 | 292 |
| Nov. 20 | 2.2 | 0.24 | 3 | 211 |
| Nov. 21 | 1.2 | 0.19 | 3 | 227 |
| 1986 Jan. 24 | 0.82 | 0.10 | 3 | 233 |
| Jan. 25 | 4.8 | 0.15 | 5/3 | 352 |
| Jan. 26 | 2.1 | 0.15 | 5/3 | 310 |
| Jan. 27 | 2.1 | 0.24 | 3 | 300 |
| Jan. 28 | 1.5 | 0.19 | 3 | 292 |
| Mar. 19 | 0.98 | 0.09 | 3 | 199 |
| Mar. 20 | 4.0 | 0.20 | 5/3 | 352 |
| Mar. 21 | 3.3 | 0.18 | 5/3 | 324 |
| Mar. 22 | 2.0 | 0.17 | 5/3 | 303 |
| Aug. 27 | 0.82 | 0.13 | 3 | 300 |
| Aug. 28 | 2.8 | 0.12 | 3 | 294 |
| Aug. 29 | 3.8 | 0.16 | 3 | 294 |
| Aug. 30 | 3.6 | 0.19 | 3 | 270 |
| Aug. 31 | 1.5 | 0.15 | 3 | 228 |

([1]) Maximum/Minimum

A review of plant performance during periods with higher than average raw water turbidities was carried out. Table E.3 presents plant operating data for periods with higher than average raw water turbidities. Data selection was based on:

- above normal raw water turbidities;
- filtered water effluent turbidity higher than normal.

By examining the data in Table E.3 it will be noticed that:

- filter effluent turbidities were low for the entire duration of adverse raw water quality conditions. Effluent turbidity values ranged from 0.09 to 0.28 NTU and the overall average was 0.15 NTU;

- at no time was the drinking water objective for turbidity of 1.0 NTU exceeded in the filtered water, and, in fact, effluent turbidity never went above 0.3 NTU.

It is postulated that the high quality filter effluent was achieved on account of the following main reasons:

- the change in average day raw water turbidity levels was relatively small;

- appropriate adjustments were made in the coagulant dosages;

- filter rates that were in effect generally were less than the design rate.

Process loading characteristics for actual 1986 plant flows (yearly average, maximum day and minimum day) and the design flow rate are given in Table E.4 for the flash mixers, in-line pipe flocculators, flocculation tanks, and filters. In examining the table, it will be noticed that the Gt product for in-line pipe flocculation of 9,900 is low in comparison with the operating Gt product of 31,200 to 51,200

achieved with a minimum energy input of 20 $s^{-1}$ for mechanical flocculation. Also, it will be observed that the filter rate of 13.5 m/h for the maximum day flow rate in 1986 is slightly in excess of the MOE guideline of 12 m/h. Other parameters fall within the acceptable ranges recommended for design of such processing units.

Filter performance is generally measured in terms of effluent quality in relation to turbidity; however, the length of filter run is also important in establishing the filter's net water production capability. Solids loadings, turbidity, coagulating chemicals and algae, will influence the length of filter runs.

During 1986 the monthly average filter runs varied from about 22 hours to 56 hours; the average monthly filter run time for the year was about 41 hours. The minimum monthly average occurred for July 1986 when algae counts in the raw water averaged 837 ASU/mL for the month. In examining the data for July 1986 in more detail, the following observations were made:

| | 4 July 1986 | 10 July 1986 |
|---|---|---|
| - raw water flow, ML/d | 374.5 | 524.3 |
| - number of filter backwashes | 8 | 15 |
| - number of filters in operation | 7 | 6 to 7 |
| - duration of filter runs, hours | 21 | 10.4 |
| - algae concentration in raw water, ASU/mL | 2,503 | 838 |

The length of filter run, achieved with the highest recorded level of algae in the raw water of 2,503 ASU/mL was 21 hours. A much lower run time of 10.4 hours occurred on July 10, 1986 with only 838 ASU/mL of algae in the raw water. In each case filter clogging algae species were present. The higher flow rate on July 10 is the main reason for the large difference in filter runs that occurred. The number and type of algae present will also affect the length of filter runs.

## TABLE E.4

## EASTERLY FILTRATION PLANT - PROCESS LOADING CHARACTERISTICS

| Process Unit | 1986 Plant Flows, ML/d Yearly Avr. 279.0 | Max. Day 524.3 | Min. Day 159.9 | Design Flow, ML/d 454.6 |
|---|---|---|---|---|
| Flash Mixing | | | | |
| - Detention Time[1], s | 0.24 | 0.17 | 0.28 | 0.2 |
| - G Value, $s^{-1}$ | 1,000 | 1,000 | 1,000 | 1,000 |
| - Gt Product | 240 | 170 | 280 | 200 |
| In-Line Flocculation | | | | |
| - Detention Time[1], s | 57.5 | 40.9 | 67 | 47.2 |
| - G Value, $s^{-1}$ | 171 | 241 | 147 | 209 |
| - Gt Product | 9,900 | 9,900 | 9,900 | 9,900 |
| Mechanical Flocculation | | | | |
| - Detention Time[1], s | 2,200 | 1,560 | 2,560 | 1,800 |
| - G Value, $s^{-1}$ | 20 | 20 | 20 | 20 |
| - Gt Product | 44,000 | 31,200 | 51,200 | 36,000 |
| Filtration | | | | |
| - Filter Rate, m/h | 7.2 | 13.5 | 8.82 | 11.7 |

1 Based on 113.7 ML/d Design Rate per Pretreatment Module

2 4 Filters in Operation

The monthly average filter wash water consumption during 1986 varied from 1.1 to 2.7 percent of the total water filtered; the average was 1.84 percent. On July 4, 1986 with 8 filter washes per day, 2.89 percent of the filtered water was used for cleaning of the filters; whereas on July 10, 1986, when 15 washes were needed to clean the filters, the rate of wash water consumption was 3.17 percent. The latter rate of wash water consumption was the highest incurred during 1986.

The above rates of backwash water consumption are normal for direct filtration of Lake Ontario source water utilizing dual media, gravity filters.

c) Treatability tests

Jar tests were performed on Lake Ontario water taken from the Easterly plant on February 3, 1988. Three tests were carried out to establish the optimum coagulant dosage for treatment, one with alum and two with polyaluminum chloride (PACl). The parameter evaluated in selecting the optimum dosage was turbidity of filtrate from a laboratory filter paper.

Test procedures and results obtained are presented in Appendix B. Plots of the filtered water effluent turbidity versus the coagulant dosage applied in each jar are also presented in order to graphically illustrate the effect of coagulant dosage on the filterability of the pretreated water.

The raw water quality for the three tests was as follows:

| | Jar Test 1 | Jar Test 2 | Jar Test 3 |
|---|---|---|---|
| Turbidity, NTU | 0.86 | 0.94 | 0.91 |
| Colour, ACU | 5 | 5 | 5 |
| Temperature, °C | 1.0 | 1.0 | 1.5 |
| pH, units | 8.16 | 8.17 | 8.15 |

Based on filtér effluent turbidity, Test 1 established the range for the optimum PACl dosage to be between 0.5 and 1.5 mg/L. Although no visible floc was formed in this dosage range, a filter effluent turbidity as low as 0.08 NTU was achieved.

In Jar Test 2, the PACl dosage was varied in 0.2 mg/L increments from 0.2 to 1.2 mg/L. Turbidity measurements on the filtrate for each jar showed that good filtered effluent quality of 0.10 NTU and lower could be achieved with doses of 0.6 mg/L and higher. Depending upon the filter effluent quality objective, the optimum PACl dosage for treatment of the raw water used in the test would fall between 0.6 and 1.2 mg/L.

Jar Test 3 was carried out with alum as the coagulant. The results show that the best alum dosage for treatment of the test water would be in the order of 3.0 or 4.0 mg/L relative to a filtrate effluent turbidity of 0.10 NTU and lower. In reference to Table 2.1 of the plant operating protocol, it was observed that an alum dose of 3.0 mg/L has been used full-scale in treatment of raw water with turbidities of similar order of magnitude to that of the test water.

Experience has shown that the glass fibre filters used in the jar test give results that are very close to the performance of full-scale dual media filters.

d) <u>Capability of Existing Plant</u>

Since start-up of the Easterly Filtration Plant, a maximum day raw water flow of 524.33 ML/d was recorded for July 10, 1986. This treatment rate exceeded the design capacity of the plant by 15.3 percent. The operating record for this day was as follows:

- Raw Water turbidity, NTU
  - range — 0.9 to 1.9
  - average — 1.2

| | |
|---|---|
| - algae in raw water, ASU/mL | 838 |
| - alum dosage applied, mg/L | 3 min./3 max. |
| - composite filter effluent turbidity achieved, mg/L | |
| · range | 0.09 to 0.14 |
| · average | 0.12 |
| - number of filter backwashes | 15 |
| - percentage of wash water used | 4.0 |
| - average length of filter runs achieved (based on service factor of 81%), h | 10.4 |

The record shows that excellent performance was achieved in spite of the high treatment rate and relatively high raw water algae content. Although 15 backwashes were required to maintain filter operations and the length of run was little more than 10 hours only 4.0 percent of backwash water was consumed for the day which is about the same as the average consumption for a conventional plant. As a result of this case history, no problems are anticipated in achieving the design flow capacity of the plant under existing raw water quality conditions of the source water.

## E.2.2 OPTIMUM PERFORMANCE OPTIONS

The operational record, reviewed and discussed in the previous section, indicates a high degree of performance is being achieved by the plant with regard to the removal of particulate matter. Several alternatives that might further improve the removal of particulate matter include the following:

### Option 1 - Coagulant Chemical

Polyaluminum chloride (PACl) is being used as an alternate coagulant to alum. The use of PACl should be continued in order to collect sufficient data upon which a complete evaluation of the effectiveness and economics of PACl as a coagulant of choice for the treatment of raw water at the Easterly plant can be made.

Option 2 - Flocculant Aid

In line flocculators have a very short retention time, less than 1-minute at the design flow rate. Several researchers have indicated that at low water temperatures chemical reactions are slow and that with insufficient flocculation time a problem may occur with "after-floc" formation. In reviewing the data for aluminum residuals in the treated water in relation to raw water temperature, no direct relationship is discernible and the effect of the above hypothesis does not appear to take place. But upon further examination it was observed that the aluminum residual is measured in the plant output sample which, at the design flow rate, is over 5-1/2 hours after the addition of the alum in the in-line flocculators. This long detention time allows the "after-floc" that is formed to settle out in the clear well and reservoir and is therefore not detected by the analyses.

Based on the fact therefore that "after-floc" formation does not occur, and that the speed of the chemical reaction of the coagulant (alum or PACl) may be enhanced by the addition of a polyectrolyte flocculant aid, it is suggested that investigations be carried out to determine the benefits, if any, that may be achieved from the use of a polyelectrolyte as a flocculant aid during the cold weather season. The tests will also need to determine the type of polyelectrolyte that should be used - either cationic or non-ionic, for achieving the best results.

Option 3 - Filter Aid

Non-ionic polyers have been used with success in the direct filtration process to strengthen the alum floc in order to prolong a filter run. Some researchers have also found that non-ionic polymer applied as a filter aid will improve filter effluent quality and reduce the filter ripening period following start-up of a washed filter.

In order to improve upon the filter effluent turbidities being achieved, it is suggested that investigations be carried out to determine the benefits of using a non-ionic polymer filter aid at the Easterly Plant.

Option 4 - Filter Operation

In addition to optimum pretreatment, the performance of the dual media high rate filters depends upon:

(1) minimizing hydraulic surges;
(2) adding a polymer or inorganic coagulant (non-ionic or anionic polymer, or alum) to the filter backwash water to reduce the filter ripening period;
(3) increasing filter rate uniformly at start-up over a 10 to 30 minute period;
(4) allowing a filter to rest for about 15-minutes after a wash before reinstatement into service;
(5) modifying filter effluent piping to permit filtering to drain at start-up.

Option 4(1) - Hydraulic Flow Surges

Hydraulic surges within a filter generally result in deteriorated filter effluent quality. Surges can occur in on-line filters due to a sudden change in flow rate as a result of increased pumping or when a filter is taken out of service for backwashing. These surges may be as critical to filter effluent quality as is the hydraulic surge that occurs during start-up of a filter after backwashing.

Surges in on-line filters can be minimized by maintaining the maximum numbers of filters in operation thus filtering at the lowest possible rate and by minimizing the rate of change of raw water pumping.

At the Easterly plant hydraulic surges due to a change in raw water pumping or filter washing operations, are being controlled by the use of ramp generators with pneumatic control valves. In general, valves are set to open and close at constant rate over a duration of 3-minutes for each function. Raw water flow is changed incrementally at a maximum rate of change of 113.65 ML/d equal to the capacity of a small raw water pump. All in-service filters react equally and at constant rate

to accommodate the change in flow rate (increase or decrease). On increasing flow rate pumps are brought on-line through the flocculation tanks which further prevents an instantaneous surge from reaching the filters.

Filter backwashing operations which require a filter to be taken off-line and later to be placed back into service do not impose as great a strain on the filters as does the operation of changing raw water pumpage. For example, at the design flow rate the maximum rate of change to be accommodated during a backwash cycle with all 8-filters in service is 56.8 ML/d, whereas the raw water pumping rate can change by two times as much or 113.6 ML/d. As with changes in raw water flow rate, all filter rate control valves act simultaneously and at constant rate over a 3-minute period to absorb the changes in filter rate that occur when backwashing a filter. The duration for re-positioning of the rate control valves is adjustable to a maximum of 30 minutes.

Although the operating record does not reveal any adverse impact due to hydraulic surges on filter performance, it appears that satisfactory results are achieved with the current operating practice.

Option 4(2) - Filter Conditioning

As with the use of a filter aid, filter conditioning, by adding a polymer or inorganic coagulant (non-ionic or anionic polymer, or alum) to the wash water near the end of the backwash cycle, may reduce the peak and duration of the initial high turbidity during the filter ripening period.

This practice of pre-conditioning a filter has been under investigation at the Easterly plant for some time. Results, apparently, are promising and show that the process is beneficial to the operation of a filter. The technical literature reports on similar findings at several plants in the United States where filter pre-conditioning is being used. Consequently, it is understood that the process will be implemented at the Easterly plant on a full-time basis.

Option 4(3) - Slow Start-up of Filter

Allowing a filter to rest after a wash is already being used at the Easterly plant, and if warranted, this practice should be continued. The practice is based on the assumption that during the rest period the filter media will compact and return to conditions similar to those prior to backwashing.

Option 4(5) - Filter to Drain

A further option for reducing the initial high filter effluent turbidity immediately after start-up is to filter to drain. Special filter effluent piping equipped with automatically controlled valves would be required for implementation of this option. It is suggested that the feasibility and benefits of filtering to drain be established by full-scale testing at reduced filter rates using the manually controlled filter drain pipe.

Modifications to filter effluent piping would be expensive and may not be practical since a new waste water header would be required to convey the flow to the surge tanks. In addition, the wash water consumption would increase significantly depending upon the duration of the ripening period. At the filter design flow rate an additional 1.18 ML of water would be wasted during 30-minutes of operation which would nearly double the current rate of wash water consumption.

It is very unlikely that filtering to drain will be an acceptable alternative to the aim of filter conditioning at the Easterly plant.

## E.3 DISINFECTION

### E.3.1 PROCESS EVALUATION

#### a) Chlorination Equipment

The Chemical Building includes storage and feed facilities for the application of:

- chlorine gas
- sulphur dioxide
- aqua ammonia.

The equipment available is described in Section C.4.2 and summarized in Table C.1.

b) Application Points

Chlorine gas in solution form is applied at the Raw Water Pumping Station intake for prechlorination, at the outlet of the filtered water conduit for postchlorination (normal mode), and, in the chemical mixing channel at the outlet of the reservoir for final chlorination.

Superchlorination is practiced in the postchlorination mode when required to control high levels of bacterial contamination, trace organics, and taste and odour. The superchlorinated water is dechlorinated with sulphur dioxide gas applied in solution form in the chemical mixing channel at the outlet of the reservoir. The final effluent is ammoniated to maintain a stable residual in the distribution system. The aqua-ammonia solution is added to the flow at the south end of the chemical mixing channel.

For a detailed description of the disinfection practices employed, reference is made to Section D.3 of this Report.

c) Dosages and Control

A record of the plant's disinfection practice is presented in Tables 3.0, 3.1, 4.0, 4.1 and 6.0 of Appendix C. Table 3.0 presents a monthly summary for the years 1986, 1985 and 1984. A daily disinfection profile is presented in Table 3.1 for January, April, July and October for each of the three years studied. An overall water quality summary is given in Tables 4.0 and 4.1; while bacteriological test results are documented in Tables 6.0 on a monthly and yearly basis for 1986 to 1984.

Table E.5 following presents a 3-year summary of the chlorine dosages applied and resultant chlorine residuals. On average, the prechlorine dosage was 0.80 mg/L for 1986, 0.79 mg/L for 1985, and 0.82 mg/L for 1984. The overall range was from 0.77 to 0.83 mg/L.

The postchlorine dosages of Table E.5 represent the combined averages of normal post- and superchlorination dosages that were applied. These dosages will vary with raw water quality and have a range of 0.55 to 1.9 mg/L chlorine. The yearly average chlorine dosages were 1.0, 1.2 and 1.0 mg/L for 1986 to 1984 respectively.

Dosages for prechlorination, postchlorination and sulphur dioxide feeders for dechlorination are set remote manually and feeders are automatically paced proportional to the appropriate flow signal. A detailed description of the control of chemical dosages is given in Section D.5, Item c) for chlorine and sulphur dioxide, and Item d) for ammonia.

d) Chlorine Residuals

The prechlorine residual is monitored continuously by chlorine analyzer as mg/L free chlorine. The average free chlorine residuals for 1986 to 1984 were 0.28, 0.24 and 0.26 mg/L respectively and ranged from 0.12 to 0.45 mg/L over the 3-year period.

The total chlorine residual is monitored in the plant output by an on-line automatic analyzer. The yearly summary in Table E.5 shows average total chlorine residuals of 0.75 mg/L for 1986 and 1985, and 0.72 mg/L for 1984; the range in residuals was 0.66 to 0.82 mg/L for the 3 years.

e) Process Evaluation

The prechlorine dose is selected to meet the plant's objective of maintaining a slight free chlorine residual in the filtered water. For an average chlorine dosage of 0.80 mg/L and an average free chlorine residual of 0.26 mg/L experienced over the study period, the chlorine

demand is about 0.54 mg/L. This chlorine demand is fairly constant but will vary somewhat with the seasonal changes in raw water quality. From Table 3.0 for instance, it will be noticed that the chlorine demand increased in the summer time to about 0.65 mg/L in August 1986 as a result of increased levels of algae in the raw water. The chlorine is applied before the raw water pumps and, at the design flow rate, has minimum contact times prior to entering the clear well of about 58 minutes with mechanical flocculation and about 27 minutes with in-line flocculation.

The average monthly pH of the raw water is about 8.1 units. During the summer time monthly average values are somewhat higher at 8.2 units while daily maximum values of 8.4 units have been observed. At these pH levels disinfection may be inefficient but in view of the available contact times and the chlorine residual in the water, the prechlorination process functions as intended. This is confirmed by the very low frequency of occurrence of total coliform organisms in tests on prefiltered water and samples taken directly from above the filters.

The pH of the prefiltered water is, on average, about 0.25 units lower than that of the raw water; the average monthly value for 1986 was 7.85 units and varied from 7.8 to 8.1 units. At this slightly lower pH range the postchlorination process functions more efficiently then the prechlorination process.

One disadvantage of the prechlorination process is the potential for forming trihalomethanes. However, based on results of the MOE DWSP program, the levels of TTHM formed at the Easterly plant are very low, a value of 23 µg/L was measured on a sample taken on June 15, 1987, and prechlorination does not appear to be a problem in this regard.

Postchlorination serves as the final disinfection process. It may consist of normal postchlorination, as described previously, or superchlorination when raw water is suspect of being highly contaminated with microorganisms, or when taste and odour is present.

## TABLE E.5

## CHLORINATION - 3-YEAR SUMMARY

| Parameter | 1986 Min. | 1986 Max. | 1986 Avg. | 1985 Min. | 1985 Max. | 1985 Avg. | 1984 Min. | 1984 Max. | 1984 Avg. |
|---|---|---|---|---|---|---|---|---|---|
| **Prechlorination** | | | | | | | | | |
| Chlorine Dosage | 0.77 | 0.81 | 0.80 | 0.77 | 0.81 | 0.79 | 0.79 | 0.83 | 0.82 |
| Free Chlorine Residual | 0.15 | 0.45 | 0.28 | 0.12 | 0.31 | 0.24 | 0.12 | 0.31 | 0.36 |
| **Postchlorination** | | | | | | | | | |
| Chlorine Dosage | 0.55 | 1.5 | 1.0 | 0.85 | 1.9 | 1.2 | 0.55 | 1.8 | 1.0 |
| Total Chlorine Residual | 0.70 | 0.82 | 0.75 | 0.71 | 0.79 | 0.75 | 0.66 | 0.77 | 0.72 |

Units in mg/L

Free ammonia at a level of 0.02 mg/L is used as a surrogate parameter to indicate conditions of raw water pollution and to trigger the start of superchlorination. Contact time is provided by the clear well which has a fixed storage volume of 24,000 $m^3$ and the reservoir which has a maximum capacity of 70,000 $m^3$. At the design flow rate the theoretical detention time in the clear well is 1.27 h. Additional retention time is provided by the reservoir which can vary from 1.3 to 3.7 h for low and high water levels. Good contact is ensured by the longitudinal flow path into the individual sections of the clear well and through the reservoir.

Superchlorination is used for a large percentage of the time throughout the year. The average free chlorine residual after postchlorination will vary from 0.7 to 1.55 mg/L depending upon which mode of chlorination was used. Sulphur dioxide is used for dechlorination to maintain a free chlorine residual of 0.45 to 0.65 mg/L in the output before ammoniation. As shown in Table E.5, the average chlorine dosage required to achieve the above levels of chlorine residual varied from 0.55 to 1.9 mg/L. Based on an assessment of applied chlorine dosages, chemical contact time, and chlorine residuals that have been achieved, it can be concluded that the chlorination process is highly efficient. In reviewing the bacteriological water quality data for 1986 to 1984 as presented in Table 6.0, it was noted that all tests for fecal coliform and fecal streptococcus organisms in the treated water were negative. Test results for total coliform organisms also were nearly always negative; those that tested positive had a very low count of 1 organism per 100 mL. In such cases, the monthly geometric mean in Table 6.0 is shown as a decimal value. As an approximation, such results may be interpreted as a frequency of occurrence. For example, the geometric mean of 0.004 counts/100 mL for June 1986 may mean that 0.4 percent of the tests performed were positive at 1 count/100 mL, which is well within the 10 percent objective for the total number of samples analyzed in a 30-day period.

Since germicidal effectiveness is pH and temperature dependent as well as on chlorine dose and contact time, some variation in the efficiency

of disinfection would normally be expected. However, the actual performance achieved during the study period with respect to normal indicator bacteria is exceptionally good and indicates that a consistently high level of disinfection is being achieved all the time.

Following postchlorination and fluoridation of the water, the pH of the plant output is about 0.5 to 0.6 units lower than the raw water pH. Most of this decrease is due to chlorination and fluoridation of the water. For 1986 the average treated water pH was 7.85 units; while the range for the 3-year period was 7.57 to 7.85 units. This is a desirable range of pH for distribution. A downward pH adjustment of the raw water to increase the efficiency of the pre- and postchlorination processes may therefore not be warranted since a second upward pH adjustment may be required for the final plant output.

### E.3.2 CAPABILITY OF EXISTING PLANT

The existing practice of pre- and postchlorination is very effective in producing a high quality water free of microorganisms. The practice should be continued in the future for disinfection of Lake Ontario water. Sufficient equipment capacity is available to treat the maximum hydraulic flow rate through the plant.

### E.3.3 OPTIMUM DISINFECTION PROCEDURES

Having reviewed the existing chlorination practice in detail, it was found that no modifications are required to be undertaken at this time to improve the process.

## E.4 OTHER CONCERNS

### E.4.1 TASTE AND ODOUR CONTROL

Samples of filtered water and plant output are taken hourly and tested by the operator for taste characteristics including chlorophenol, earthy, foul, and weedy tastes. If a chlorophenol taste is detected,

the water is superchlorinated with a minimum total chlorine dosage of 3.0 mg/L. Other tastes are generally treated by adjusting the post-chlorine dosage.

Chlorination for the control of taste and odour has been very successful at the Easterly plant. The operational data for 1986 to 1984 show that no tastes were detected in the output water over the entire 3-year study period. Unfortunately, the taste quality of the water does not remain the same in the distribution system and occasionally taste complaints have been received by the Water Quality Division.

### E.4.2 FLUORIDE

The treated water is fluoridated using hydrofluosilicic acid for the control of dental caries in children.

Raw water fluoride concentrations vary from 0.12 to 0.14 mg/L for the 3-year record while the yearly average was 0.13 mg/L. Monthly average day dosages that were added to the treated water ranged from 0.96 to 1.10 mg/L for 1986, 1.01 to 1.04 mg/L for 1985, and 0.76 to 1.03 mg/L for 1984. The monthly average day fluoride residuals for the same years were 1.03 mg/L, 1.02 mg/L, and 0.89 mg/L respectively.

The recommended optimum fluoride concentration in the treated water under the Ontario Drinking Water Objectives is 1.2 mg/L and the acceptable range is 1.0 to 1.4 mg/L. This objective has been met in 1986 and 1985, and, on an average basis, also in 1984. In reviewing the records of Tables 3.0 and 3.1, it is evident that during the first half of 1984, except for March, monthly average residuals were less than 1.00 mg/L and ranged from a low of 0.93 mg/L to a high value of 0.99 mg/L; the average for March was 1.00 mg/L and for the second half of the year monthly residuals varied from 1.08 to 1.19 mg/L.

### E.4.3 ALUMINUM IN RAW AND TREATED WATER

The aluminum content of raw and treated water is analysed in the plant laboratory by spectrophotometer. Results are tabulated in Table 2.0 in

terms of monthly maximum, minimum and average values. The total aluminum (dissolved plus suspended) content is given for the raw water whereas the dissolved aluminum as determined on a filtered sample is given for the treated water except for a few results (as noted) in 1984 which are total aluminum.

The monthly average day readings for raw water range from 0.005 to 0.227 mg/L for 1986 to 1984; average values for 1986 and 1985 were 0.059 and 0.112 mg/L respectively. The monthly average raw water pH for 1986 and 1985 varied from 8.0 to 8.3 and the overall average was 8.15 units. The technical literature indicates that at equilibrium the minimum solubility of aluminum hydrolysis species is 0.004 mg/L Al at pH 5.8 and increases logarithmically with increasing pH to about 1.7 mg/L Al at pH 8.5. Values of 0.1 to 1.0 mg/L Al are normally found in surface waters within the above pH range.

For the treated water the dissolved aluminum content was as follows:

| | Treated Water Characteristics | |
|---|---|---|
| | 1986 | 1985 |
| Aluminum, mg/L | | |
| - Range | 0.050 - 0.134 | 0.073 - 0.148 |
| - Average | 0.094 | 0.119 |
| pH, units | | |
| - Range | 7.4 - 7.7 | 7.4 - 7.7 |
| - Average | 7.55 | 7.55 |

In a pure system at pH 7.55 the solubility of aluminum hydroxide species at equilibrium is about 0.34 mg/L Al. In comparison, the aluminum residuals in the plant output were quite low and are less than the maximum value attainable at equilibrium for a pH of 7.55.

### E.4.4 OPTIMIZATION OF COAGULATION PROCESS

Since the optimum pH range for alum coagulation lies between 6 and 7.5 for turbidity removal, and perhaps between 6 and 8.5 with PACl, the

efficiency of the coagulation process may be improved with a lower system pH. In addition, the level of "after-floc" formation can be minimized by reducing the system pH to a slightly acidic value. For instance, at a system pH of 6.5 coagulation with alum or PACl would be more effective than at the natural, high raw water pH levels. Also, the level of "after-floc" formation and dissolved aluminum residual would be significantly reduced since the solubility concentration of aluminum hydrolysis species at pH 6.5 is only in the order of 0.034 mg/L.

Optimization of the coagulation process therefore, would require provision of an acid feed system - sulphuric or hydrochloric acid, to reduce the natural raw water pH before coagulation and a lime or caustic soda feed system for final pH adjustment of the treated water. It is expected that at the lower system pH the optimum coagulant dosage for the entire turbidity range encountered at the Easterly plant would be lower and, in view of the lower floc solubility, the speed of the chemical reaction may increase which should improve in-line flocculation with cold water and reduce the "after-floc" formation. Also, the lower system pH would improve the overall efficiency of disinfection.

In summary, the benefits to be achieved with a lower system pH for treatment are as follows:

- lower consumption of coagulant;

- improve efficiency of coagulation with cold water using in-line flocculation;

- reduce the after-floc formation and precipitation of aluminum hydrolysis products in the clear well, reservoir, and distribution system;

- lower the aluminum residual in the treated water;

- improve the efficiency of the disinfection process.

As such, it is suggested that investigations be carried out to determine the feasibility and cost implications of this coagulation optimization process for possible future implementation at the Easterly Filtration Plant.

## E.4.5 STABILITY OF WATER

The Langelier Saturation Index (L.I.) is commonly used in water conditioning calculations and is defined as:

$$L.I. = pH - pHs$$

where: pH = pH of system as measured by pH meter

pHs = saturation pH at which the total alkalinity and the calcium hardness would be at equilibrium with each other and with solid calcium carbonate.

Temperature and total dissolved solids content will influence the value of pHs. If the L.I. is negative and dissolved oxygen is present, water tends to corrode ferrous piping. If the L.I. is positive and water contains much calcium and alkalinity, deposits and scale may form.

The Langelier Index for Lake Ontario water at the Easterly plant varied from about -0.70 in the winter to -0.40 in the summer. For the treated water the L.I. was determined as -1.25 in the winter and -1.15 in the summer. This calculation shows that while undergoing treatment the aggressiveness of the water increases slightly and will, in the presence of oxygen, corrode metal piping.

Corrosion coupon tests should be carried out to determine the degree of corrosiveness of the treated water and whether corrective measures need to be implemented.

# SECTION F

# RECOMMENDATIONS

# SECTION F - RECOMMENDATIONS

## F.1 SHORT-TERM MODIFICATIONS

### F.1.1 PARTICULATE REMOVAL

#### 1. Chemical Coagulant

Polyaluminum chloride has been used by plant personnel as the chemical coagulant since September 1986. A preliminary assessment of its effectiveness would indicate that the product is as effective as and, perhaps, more effective than alum with certain raw water quality. In this regard therefore, it is recommended that a summary report be prepared on this trial period which would document the operating record and include evaluations on the performance and behaviour of PACl as the chemical coagulant at the Easterly treatment plant.

#### 2. Flocculant Aid

Investigate the effectiveness and benefits of using a cationic or non-ionic polyelectrolyte as a flocculant aid, especially for use during the cold weather periods of the year, in order to increase the performance of the coagulation process.

#### 3. Adjustment of System pH

Carry out studies to establish whether pH adjustment of the raw water, with final readjustment of the treated water, should be implemented in order to optimize the performance of the coagulation process.

#### 4. Filter Aid

Investigate the benefits of using a non-ionic polyelectrolyte as a filter aid in the treatment process to increase the performance of the filters.

5. Filter Conditioning

a) Conditioning of Backwash Water

Continue investigations into the feasibility and effectiveness of pre-conditioning a filter during the backwash using a non-ionic polymer or inorganic coagulant to reduce the level and duration of the initial high turbidity during the filter ripening period.

b) Slow Start-Up of Filter

Investigate the effect of a slow start-up of a filter at uniform rate over a 10 to 30-minute period on filter performance during the ripening period.

c) Filter to Drain

An alternative method for conditioning a filter to improve filter effluent quality immediately after start-up is to filter to drain. This procedure should be investigated, at reduced filter rates, using the manually controlled filter drain pipe.

6. Corrosiveness of Treated Water

Establish the corrosiveness of the treated water and determine whether corrective measures need to be implemented.

F.1.2 DISINFECTION

The existing practice at the Easterly plant for disinfection of the treated water was found to be very effective in controlling the bacteriological quality of the treated water and no modifications are required to be carried out at this time.

## F.2 LONG-TERM MODIFICATIONS

### F.2.1 PARTICULATE REMOVAL

#### 1. In-Line Flocculation

In-line pipe flocculators were shown to have a much lower Gt product compared with mechanical flocculators. Studies should be carried out to assess what effect, if any, the lower Gt product has on the efficiency of flocculation and the resultant filter effluent turbidity.

# APPENDIX A

# DAILY LOG

EASTERLY F.P. PROCESS CONTROL LOG SHEET (1) DAY: DATE:

| TIME | PUMPAGE ML/D | | | | POLY ALUMINUM CHLORIDE | | | | POLYMER - WASTE WATER | | | | POLYMER BW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw FIT-[illegible] | Filt'd FIT-[illegible] | BW FIT-[illegible] | Output FIC-T[illegible] | Trt'd. ML/D | Time Oper. | Used L/h | Dose mg/L | Trt'd. ML/D | Time Oper. | Used L/h | Dose mg/L | Used L | Dose mg/L |
| 00:01 | | | | | | | | | | | | | | |
| 01:00 | | | | | | | | | | | | | | |
| 02:00 | | | | | | | | | | | | | | |
| 03:00 | | | | | | | | | | | | | | |
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| 24:00 | | | | | | | | | | | | | | |
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| TOTAL | | | | | | | | | | | | | | |
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| MIN. | | | | | | | | | | | | | | |
| AVE. | | | | | | | | | | | | | | |

STORAGE TANK LEVEL AT 24:00

**POLY ALUMINUM CHLORIDE**

LIT-AL1: ________ m = ________ kL
LIT-AL2: ________ m = ________ kL

POLYMER:

LIT-PO1: ________ m = ________ kL
LIT-PO2: ________ m = ________ kL
LIT-PO3: ________ m = ________ kL

HYDROFLUOSILICIC ACID:

LIT-FL1: ________ m = ________ kL
LIT-FL2: ________ m = ________ kL

AQUA AMMONIA:

LIT-AM1: ________ m = ________ kL
LIT-AM2: ________ m = ________ kL

CAUSTIC POTASH:

NO. 1 : ________ m = ________ kL
NO. 2 : ________ m = ________ kL

OPERATOR

00:01 - 08:00

08:00 - 16:00

16:00 - 24:00

| PLANT SUPERVISOR | CHIEF CHEMIST |
|---|---|
| | |

WSS 50 A (REV. 85)

EASTERLY F.P.

PROCESS CONTROL LOG SHIFT (2)

DAY:

DATE:

| TIME | PRE-CHLORINATION | | | | | | POST-CHLORINATION | | | | | | | TRIM-CHLORINATION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Scale-1 | Scale-2 | Used kg/h | | Setting | Dose | Scale-5 | Scale-6 | Used kg/h | | Setting | Signal | Dose | Scale-3 | Scale-4 | Used kg/h | | Setting | Dose |
| | WIT-CL1 | WIT-CL2 | No. 1 | No. 2 | kg/D | mg/L | WIT-CL5 | WIT-CL6 | No. 5 | No. 6 | kg/D | MA/VV | mg/L | WIT-CL3 | WIT-CL4 | No. 3 | No. 4 | kg/D | mg/L |
| 00:01 | | | | | | | | | | | | | | | | | | | |
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| TOTAL | | | | | | | | | | | | | | | | | | | |
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| MIN. | | | | | | | | | | | | | | | | | | | |
| AVE. | | | | | | | | | | | | | | | | | | | |

NSS 50 B (REV. 83)

[illegible] P.P. PROCESS CONTROL LOG SHEET (3) DAY: DATE:

| TIME | FLUORIDATION | | | | | | | DE-CHLORINATION | | | | | | | AMMONIATION | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Scales - kg | | | Used kg/h | | | Dose | Scale-1 | Scale-2 | Used kg/h | | Setting | Signal | Dose | Scale-1 | Scale-2 | Used kg/h | | Dose |
| | WIT-FL1 | WIT-FL2 | WIT-FL3 | No.1 | No. 2 | No. 3 | mg/L | WIT-SO1 | WIT-SO2 | No. 1 | No. 2 | kg/D | MA/VV | mg/L | WIT-AN1 | WIT-AN2 | No. 1 | No. 2 | mg/L |
| 00:01 | | | | | | | | | | | | | | | | | | | |
| 01:00 | | | | | | | | | | | | | | | | | | | |
| 02:00 | | | | | | | | | | | | | | | | | | | |
| 03:00 | | | | | | | | | | | | | | | | | | | |
| 04:00 | | | | | | | | | | | | | | | | | | | |
| 05:00 | | | | | | | | | | | | | | | | | | | |
| 06:00 | | | | | | | | | | | | | | | | | | | |
| 07:00 | | | | | | | | | | | | | | | | | | | |
| 08:00 | | | | | | | | | | | | | | | | | | | |
| 09:00 | | | | | | | | | | | | | | | | | | | |
| 10:00 | | | | | | | | | | | | | | | | | | | |
| 11:00 | | | | | | | | | | | | | | | | | | | |
| 12:00 | | | | | | | | | | | | | | | | | | | |
| 13:00 | | | | | | | | | | | | | | | | | | | |
| 14:00 | | | | | | | | | | | | | | | | | | | |
| 15:00 | | | | | | | | | | | | | | | | | | | |
| 16:00 | | | | | | | | | | | | | | | | | | | |
| 17:00 | | | | | | | | | | | | | | | | | | | |
| 18:00 | | | | | | | | | | | | | | | | | | | |
| 19:00 | | | | | | | | | | | | | | | | | | | |
| 20:00 | | | | | | | | | | | | | | | | | | | |
| 21:00 | | | | | | | | | | | | | | | | | | | |
| 22:00 | | | | | | | | | | | | | | | | | | | |
| 23:00 | | | | | | | | | | | | | | | | | | | |
| 24:00 | | | | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | | | | |
| MAX. | | | | | | | | | | | | | | | | | | | |
| MIN. | | | | | | | | | | | | | | | | | | | |
| AVE. | | | | | | | | | | | | | | | | | | | |

WSS 50 C (REV. 93)

EASTIPLY F.P. PROCESS CONTROL LOG SHEET (4) DAY: DATE:

| TIME | RESIDUAL CHLORINE - mg/L | | | | | | F⁻ mg/L | Temp. °C | pH | Wind Dir. & km/h | FREE AMMONIA - N - mg/L | | | | TURBIDITY - NTU | | | TASTE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | After-Pre Total AIT-CL1 | Filt.Comp Free AIT-CL2 | Cl Well Free AIC-CL3 | Bef.SO2 Free AIT-CL5 | Af.SO2 Free AIC-CL6 | Output Total AIT-CL7 | Output AIT-FL | Raw TIT-RW | Raw AIT-pH | | Raw | Filt'd | BEF.SO2 | Output | Raw AIT-TU1 | F.C. AIT-TU7 | Output AIT-TU8 | Filt'd | Output |
| 00:01 | | | | | | | | | | | | | | | | | | | |
| 01:00 | | | | | | | | | | | | | | | | | | | |
| 02:00 | | | | | | | | | | | | | | | | | | | |
| 03:00 | | | | | | | | | | | | | | | | | | | |
| 04:00 | | | | | | | | | | | | | | | | | | | |
| 05:00 | | | | | | | | | | | | | | | | | | | |
| 06:00 | | | | | | | | | | | | | | | | | | | |
| 07:00 | | | | | | | | | | | | | | | | | | | |
| 08:00 | | | | | | | | | | | | | | | | | | | |
| 09:00 | | | | | | | | | | | | | | | | | | | |
| 10:00 | | | | | | | | | | | | | | | | | | | |
| 11:00 | | | | | | | | | | | | | | | | | | | |
| 12:00 | | | | | | | | | | | | | | | | | | | |
| 13:00 | | | | | | | | | | | | | | | | | | | |
| 14:00 | | | | | | | | | | | | | | | | | | | |
| 15:00 | | | | | | | | | | | | | | | | | | | |
| 16:00 | | | | | | | | | | | | | | | | | | | |
| 17:00 | | | | | | | | | | | | | | | | | | | |
| 18:00 | | | | | | | | | | | | | | | | | | | |
| 19:00 | | | | | | | | | | | | | | | | | | | |
| 20:00 | | | | | | | | | | | | | | | | | | | |
| 21:00 | | | | | | | | | | | | | | | | | | | |
| 22:00 | | | | | | | | | | | | | | | | | | | |
| 23:00 | | | | | | | | | | | | | | | | | | | |
| 24:00 | | | | | | | | | | | | | | | | | | | |
| TOTAL | | | | | | | | | | | | | | | | | | | |
| MAX. | | | | | | | | | | | | | | | | | | | |
| MIN. | | | | | | | | | | | | | | | | | | | |
| AVE. | | | | | | | | | | | | | | | | | | | |

WSS 50 D (REV. 83)

# APPENDIX B

# JAR TEST RESULTS

## JAR TEST PROCEDURE

1. Obtain sufficient raw water sample to test for raw water quality (turbidity, pH, temperature, colour, alkalinity) and to fill 6 1.5 L glass jars with exactly 1 L of sample.

2. Place all 6 jars in the gang stirrer and begin mix at 100 rpm. Quickly add the desired amount of primary coagulant to each jar. Add the coagulant to the vortex created by the fast stirring paddles. After coagulant has been added to the last jar, continue rapid mix for 60 seconds, then reduce the paddle speed to 30 rpm.

3. If secondary coagulant is to be used as well, quickly add this in the desired amount to each jar during rapid mix. If the secondary coagulant is a polymer, then this should be added after the addition of primary coagulant. If activated silica is used, then the order of addition should be noted.

4. Continue slow mix at 30 rpm for 30 minutes. After 30 minutes, the paddles should be stopped and removed from the jars.

5. Following the start of the slow mix, observe the time of the first appearance of visible floc in each of the six jars, and also the appearance, size and quantity of floc at the end of the agitation or flocculation period.

6. After 30 minutes of slow mix allow the samples to settle. From a fixed depth of 5 cm, the mid-point of the water depth in the jar, collect samples at 1,2, 4 and 8 minutes after the start of settling and analyse samples for turbidity. Samples drawn at these times represent settling velocities of 5, 2.5, 1.25 and 0.625 cm/min. respectively. Plot the results in terms of settling velocity distribution curves.

7. Following the settling period, pipette 200 mL of supernatant from each jar. Use 50 mL to wet a glass fibre filter disc and discard. Filter the remaining sample and measure the turbidity of the finished water. Use a separate filter apparatus and filter disk for each sample from each jar. Use Gelman Sciences Type A/E 47 mm glass fibre filters or Whatman No. 40 filter discs.

8. For direct filtration eliminate the settling step in Item 6., go directly to Item 7. and filter the samples.

ORONTO EASTERLY FILTRATION PLANT

JAR TEST RESULTS

| AW WATER CHARACTERISTICS | | |
|---|---|---|
| URBIDITY | : | 0.86 NTU |
| OLOUR | : | <5 ACU |
| EMPERATURE | : | 1° C |
| H | : | 8.16 |

JAR TEST NUMBER: 1

| | | |
|---|---|---|
| RAPID MIX | : | 1 min. @ 100 rpm |
| FLOCCULATION | : | 30 min. @ 30 rpm |
| SETTLING | : | -- |
| FILTRATION | : | 0.45 µm glass fibre |

| JAR No. | COAGULANT and DOSE (mg/L) | FLOC CHARACTERISTICS Time to 1st floc | Appearance | FILTERED WATER QUALITY Turbidity (NTU) | pH |
|---|---|---|---|---|---|
| 1 | PACl 0.5 | -- min. | -- | 0.09 | 8.13 |
| 2 | PACl 1.0 | -- min. | -- | 0.08 | 8.10 |
| 3 | PACl 1.5 | -- min. | -- | 0.08 | 8.07 |
| 4 | PACl 2.0 | -- min. | -- | 0.05 | 8.05 |
| 5 | PACl 4.0 | 10 min. | floc is light, stringy; does not settle well | 0.05 | 8.03 |
| 6 | PACl 6.0 | 6 min. | floc is slightly larger and stronger than jar 5; floc settles | 0.08 | 7.94 |

TORONTO EASTERLY FILTRATION PLANT

JAR TEST RESULTS

RAW WATER CHARACTERISTICS

TURBIDITY : 0.94 NTU
COLOUR : <5 ACU
TEMPERATURE : 1° C
pH : 8.17

JAR TEST NUMBER: 2

RAPID MIX : 1 min. @ 100 rpm
FLOCCULATION : 30 min. @ 30 rpm
SETTLING : --
FILTRATION : 0.45 µm glass fibre

| JAR No. | COAGULANT and DOSE (mg/L) | FLOC CHARACTERISTICS | | FILTERED WATER QUALITY | |
|---|---|---|---|---|---|
| | | Time to 1st floc | Appearance | Turbidity (NTU) | pH |
| 1 | PACl 0.2 | -- min. | -- | 0.18 | 8.16 |
| 2 | PACl 0.4 | -- min. | -- | 0.13 | 8.15 |
| 3 | PACl 0.6 | -- min. | -- | 0.10 | 8.13 |
| 4 | PACl 0.8 | -- min. | -- | 0.08 | 8.12 |
| 5 | PACl 1.0 | -- min. | -- | 0.09 | 8.12 |
| 6 | PACl 1.2 | -- min. | -- | 0.05 | 8.09 |

RONTO EASTERLY FILTRATION PLANT

JAR TEST RESULTS

W WATER CHARACTERISTICS

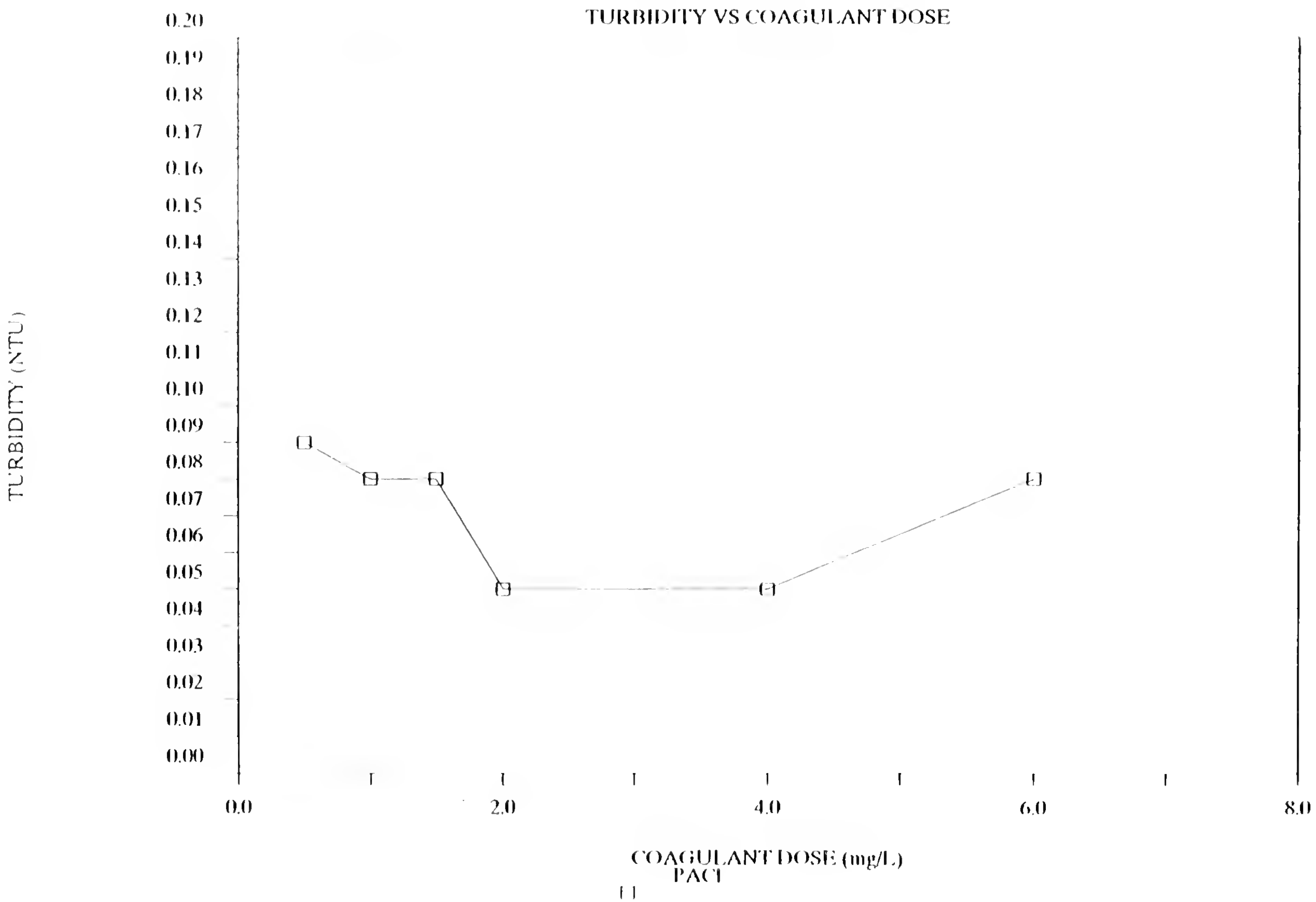
RBIDITY : 0.91 NTU
LOUR : <5 ACU
MPERATURE : 1.5° C
I : 8.15

JAR TEST NUMBER: 3

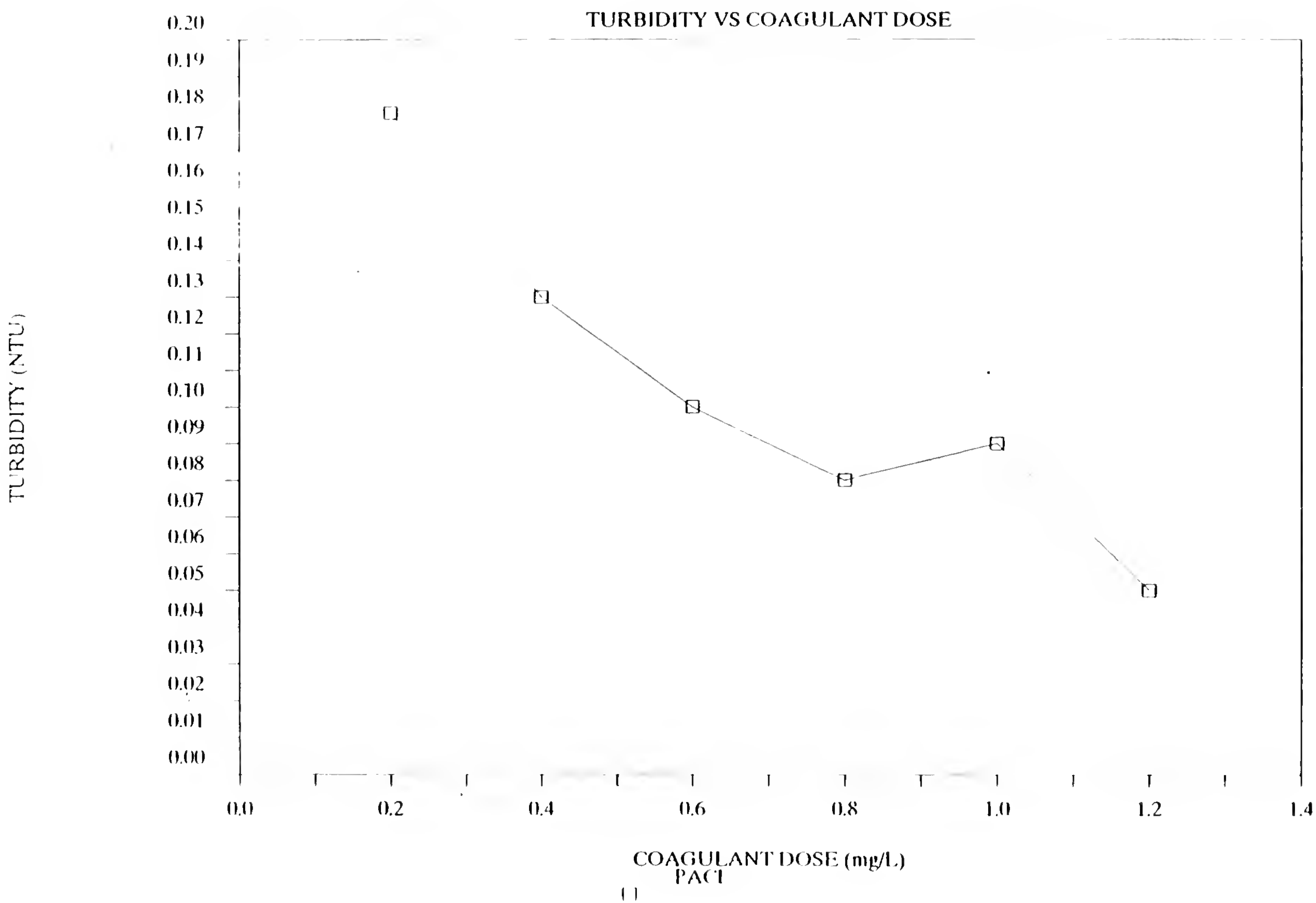
RAPID MIX : 1 min. @ 100 rpm
FLOCCULATION : 30 min. @ 30 rpm
SETTLING : --
FILTRATION : 0.45 µm glass fibre

| JAR No. | COAGULANT and DOSE (mg/L) | FLOC CHARACTERISTICS Time to 1st floc | Appearance | FILTERED WATER QUALITY Turbidity (NTU) | pH |
|---|---|---|---|---|---|
| 1 | Alum 0.5 | -- min. | -- | 0.19 | 8.16 |
| 2 | Alum 1.0 | -- min. | -- | 0.17 | 8.14 |
| 3 | Alum 1.5 | -- min. | -- | 0.16 | 8.08 |
| 4 | Alum 2.0 | -- min. | -- | 0.14 | 8.07 |
| 5 | Alum 4.0 | -- min. | -- | 0.08 | 7.99 |
| 6 | Alum 6.0 | 25 min. | pin floc; does not settle | 0.05 | 7.91 |

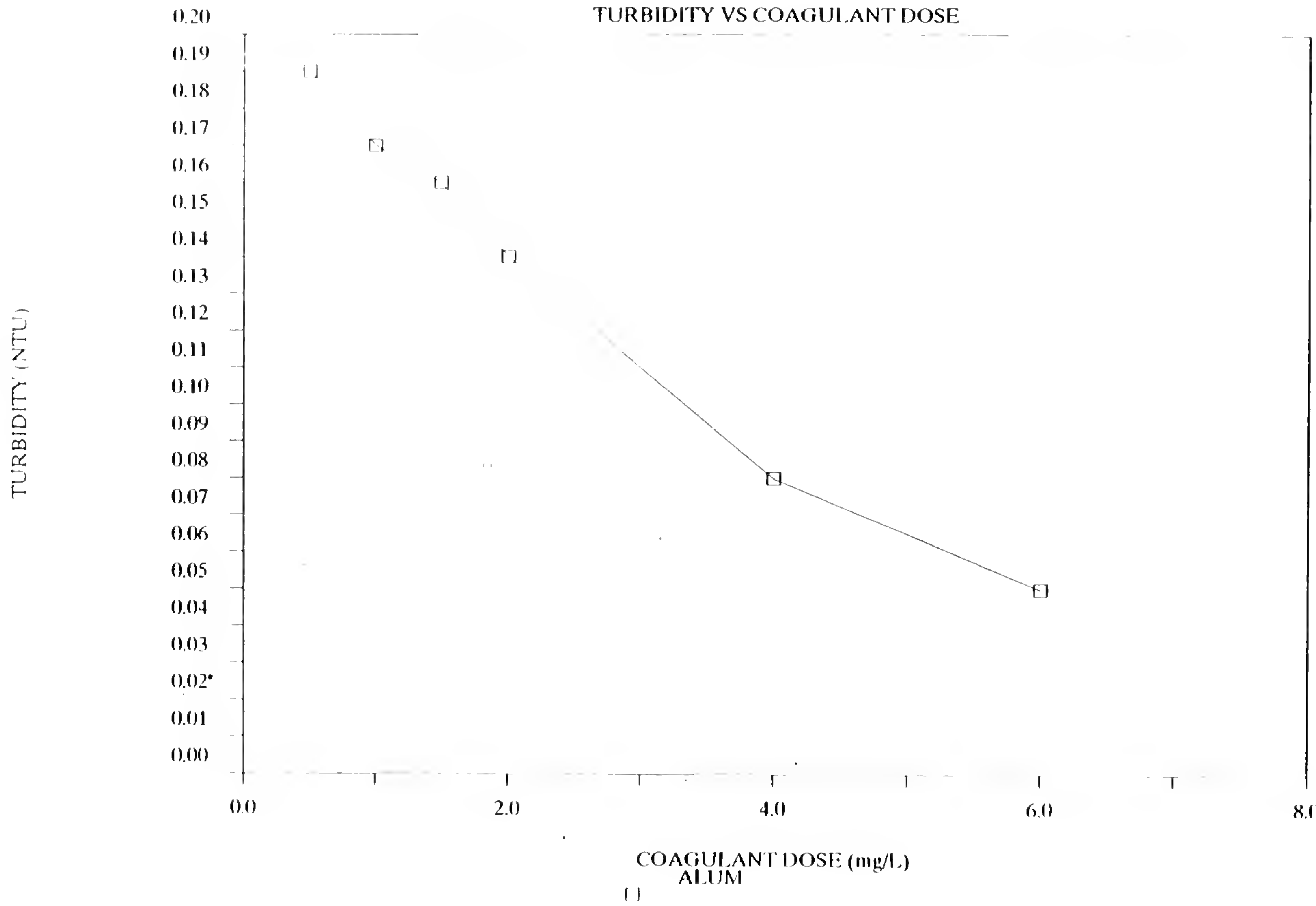
# EASTERLY WTP - RESULTS OF JAR TEST 1



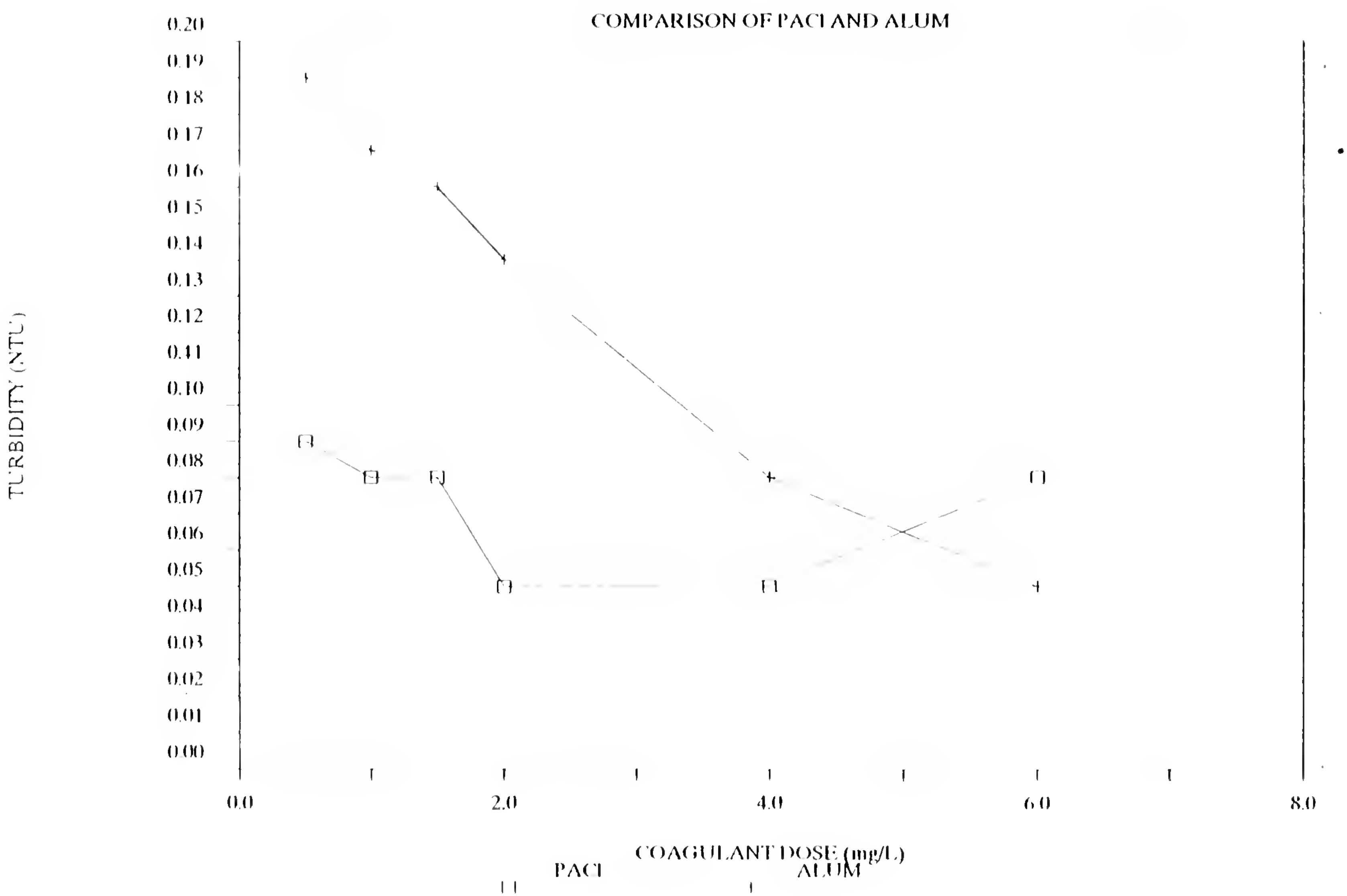
# EASTERLY WTP - RESULTS OF JAR TEST 2



# EASTERLY WTP - RESULTS OF JAR TEST 3



# EASTERLY WTP - RESULTS OF JAR TESTS



# APPENDIX C

# TABLES OF OPERATING RECORD

# TABLE 1

## WATER PLANT OPTIMIZATION STUDY
## "PLANT FLOWS"

# TABLE 2

## WATER PLANT OPTIMIZATION STUDY
## "PARTICULATE REMOVAL SUMMARY"

## TABLE 1.0: FLOWS (ML/d)



WPOS - Toronto Easterly Filtration Plant.

| MONTH | R/T | 1986 | | | 1985 | | | 1984 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAX. | MIN. | AVG. | MAX. | MIN. | AVG. | MAX. | MIN. | AVG. | MAX. | MIN. | AVG. |
| JAN | R | 381.64 | 159.94 | 238.94 | 290.25 | 193.24 | 220.51 | 259.04 | 190.42 | 184.75 | | | |
| | T | 366.30 | 154.00 | 228.25 | 285.00 | 190.00 | 211.52 | 243.16 | 183.83 | 177.69 | | | |
| FEB | R | 357.62 | 186.76 | 273.69 | 303.00 | 196.79 | 223.13 | 287.17 | 190.49 | 196.35 | | | |
| | T | 346.41 | 162.40 | 263.93 | 281.87 | 190.06 | 214.16 | 258.04 | 173.65 | 182.32 | | | |
| MAR | R | 352.35 | 189.62 | 248.59 | 295.24 | 194.42 | 225.83 | 347.43 | 186.47 | 241.64 | | | |
| | T | 329.10 | 190.70 | 239.41 | 298.50 | 190.80 | 215.16 | 335.36 | 180.54 | 231.58 | | | |
| APR | R | 355.42 | 198.69 | 277.03 | 365.46 | 197.67 | 246.31 | 334.02 | 100.96 | 255.20 | | | |
| | T | 331.36 | 190.26 | 262.60 | 339.97 | 190.52 | 234.96 | 329.83 | 181.38 | 243.77 | | | |
| MAY | R | 383.76 | 207.34 | 307.59 | 357.40 | 209.44 | 296.68 | 385.63 | 165.61 | 252.99 | | | |
| | T | 361.50 | 196.80 | 296.28 | 340.00 | 194.10 | 281.98 | 377.47 | 187.00 | 241.14 | | | |
| JUN | R | 388.73 | 170.96 | 307.79 | 373.19 | 272.43 | 323.13 | 457.03 | 215.09 | 333.82 | | | |
| | T | 378.80 | 172.40 | 295.32 | 373.30 | 260.80 | 308.97 | 429.71 | 193.56 | 314.74 | | | |
| JUL | R | 524.33 | 195.87 | 357.26 | 458.15 | 218.64 | 371.78 | 460.00 | 200.52 | 334.63 | | | |
| | T | 476.46 | 175.20 | 339.27 | 429.30 | 221.90 | 353.44 | 421.71 | 190.60 | 313.97 | | | |
| AUG | R | 366.67 | 205.95 | 290.43 | 489.52 | 219.39 | 367.57 | 457.09 | 203.25 | 347.43 | | | |
| | T | 338.47 | 192.92 | 275.77 | 458.80 | 218.24 | 348.90 | 432.85 | 193.90 | 327.54 | | | |
| SEP | R | 383.43 | 240.61 | 302.45 | 399.80 | 196.92 | 323.70 | 325.68 | 177.82 | 217.87 | | | |
| | T | 373.20 | 228.34 | 293.36 | 370.78 | 184.56 | 307.55 | 303.70 | 172.83 | 206.03 | | | |
| OCT | R | 397.20 | 232.60 | 340.14 | 333.65 | 196.19 | 245.85 | 352.30 | 182.11 | 232.13 | | | |
| | T | 383.04 | 226.00 | 328.98 | 321.90 | 186.04 | 235.80 | 331.77 | 173.62 | 219.82 | | | |
| NOV | R | 321.73 | 196.50 | 198.35 | 354.68 | 190.75 | 236.10 | 349.53 | 191.91 | 231.96 | | | |
| | T | 315.50 | 195.80 | 193.24 | 335.90 | 183.35 | 223.82 | 329.00 | 187.88 | 221.40 | | | |
| DEC | R | 333.10 | 198.74 | 206.18 | 363.35 | 153.88 | 214.06 | 319.21 | 182.81 | 220.86 | | | |
| | T | 335.00 | 196.90 | 199.93 | 336.90 | 163.80 | 203.27 | 307.22 | 175.00 | 211.51 | | | |

R = Raw; T = Treated

## TABLE 1.1: PER CAPITA CONSUMPTION (L/d/Capita)

WPOS - TORONTO EASTERLY FILTRATION PLANT

| CONSUMPTION | 1986 | 1985 | 1984 | |
|---|---|---|---|---|
| Population (1) | 464,200 | 462,760 | 419,450 | |
| Maximum Day | 1026 | 991 | 1032 | |
| Minimum Day | 332 | 354 | 414 | |
| Average Day | 577 | 565 | 574 | |
| Ratio MD:AD | 1.78 | 1.75 | 1.80 | |

(1) Population served by the Easterly plant was derived from population and consumption data for the entire Metropolitan Toronto Service Area.

## TABLE 2.0: PARTICULATE REMOVAL SUMMARY



WPOS - Toronto Easterly Filtration Plant

| MONTH | PARAMETER | | 1986 MAX. | 1986 MIN. | 1986 AVG. | 1985 MAX. | 1985 MIN. | 1985 AVG. | 1984 MAX. | 1984 MIN. | 1984 AVG. | MAX. | MIN. | AVG. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JAN | Turbidity (FTU) | R | 4.8 | 0.79 | 1.8 | 3.8 | 0.48 | 1.5 | 3.5 | 0.89 | 1.3 | | | |
| | | T | 0.22 | 0.10 | 0.16 | 0.17 | 0.14 | 0.16 | 0.35 | 0.16 | 0.28 | | | |
| | Colour (TCU) | R | 4 | 2 | 2 | 5 | 2 | 3 | 4 | 2 | 3 | | | |
| | | T | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | | 5 | 2 | 2.6 | 5 | 3 | 3.3 | 3 | 2 | 1.9 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al/Fe (2) (mg/L) | R | | | 0.122 | | | 0.178 | 0.045 | 0.014 | 0.035 | | | |
| | | T | 0.130 | 0.064 | 0.088 | 0.295 | 0.035 | 0.073 | 0.005 | 0.003 | 0.004 | | | |
| | pH | R | 8.2 | 8.1 | 8.1 | 8.2 | 8.1 | 8.2 | 8.2 | 8.0 | 8.1 | | | |
| | | T | 7.7 | 7.5 | 7.6 | 7.8 | 7.5 | 7.6 | 7.7 | 7.4 | 7.6 | | | |
| | Temperature (°C) | R | 4.5 | 2.0 | 3.3 | 4.0 | 1.5 | 2.5 | 3.5 | 0.5 | 2.2 | | | |
| FEB | Turbidity (FTU) | R | 2.7 | 0.58 | 1.3 | 2.0 | 0.44 | 1.0 | 5.6 | 0.52 | 1.8 | | | |
| | | T | 0.25 | 0.11 | 0.15 | 0.25 | 0.16 | 0.17 | 0.33 | 0.10 | 0.18 | | | |
| | Colour (TCU) | R | 4 | 2 | 2 | 5 | 2 | 3 | 4 | 2 | 3 | | | |
| | | T | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | | 5 | 2 | 2.9 | 10 | 3 | 3.5 | 4 | 2 | 2.1 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al/Fe (2) (mg/L) | R | | | 0.114 | | | 0.144 | 0.480 | 0.020 | 0.140 | | | |
| | | T | 0.132 | 0.059 | 0.085 | 0.273 | 0.048 | 0.091 | 0.020 | 0.004 | 0.008 | | | |
| | pH | R | 8.2 | 8.0 | 8.1 | 8.2 | 8.1 | 8.1 | 8.1 | 8.0 | 8.0 | | | |
| | | T | 7.7 | 7.5 | 7.6 | 7.8 | 7.5 | 7.7 | 7.7 | 7.4 | 7.6 | | | |
| | Temperature (°C) | R | 4.0 | 0.5 | 2.0 | 3.5 | 0.5 | 1.8 | 3.5 | 1.5 | 2.0 | | | |

R = Raw; T = Treated

(1) 1986 & 1985 - Alum, 1984 - Ferric Chloride.
(2) 1986 & 1985 - Al, 1984 - Fe.
Raw-Total
Treated-Filtered 1986 & 1984, - Total 1985

TABLE 2.0 (cont'd.)

| MONTH | PARAMETER | | 1986 MAX. | 1986 MIN. | 1986 AVG. | 1985 MAX. | 1985 MIN. | 1985 AVG. | 1984 MAX. | 1984 MIN. | 1984 AVG. | MAX. | MIN. | AVG. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAR | Turbidity (FTU) | R | 4.0 | 0.63 | 1.5 | 6.6 | 0.45 | 2.3 | 4.8 | 0.55 | 1.7 | | | |
| | | T | 0.30 | 0.13 | 0.19 | 0.19 | 0.16 | 0.17 | 0.14 | 0.10 | 0.11 | | | |
| | Colour (TCU) | R | 4 | 2 | 3 | 5 | 2 | 3 | 5 | 2 | 3 | | | |
| | | T | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | | 5 | 3 | 3.4 | 7 | 3 | 4.4 | 3 | 2 | 1.8 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. (2) Al/Fe (mg/L) | R | | | 0.010 | 0.275 | 0.065 | 0.170 | 0.041 | 0.018 | 0.031 | | | |
| | | T | 0.103 | 0.040 | 0.069 | 0.138 | 0.027 | 0.084 | 0.035 | 0.001 | 0.009 | | | |
| | pH | R | 8.2 | 8.1 | 8.1 | 8.2 | 8.1 | 8.1 | 8.1 | 8.0 | 8.0 | | | |
| | | T | 7.7 | 7.4 | 7.6 | 7.8 | 7.4 | 7.5 | 7.6 | 7.2 | 7.5 | | | |
| | Temperature (°C) | R | 3.5 | 1.5 | 2.3 | 3.5 | 1.5 | 2.2 | 2.0 | 0.5 | 1.3 | | | |
| APR | Turbidity (FTU) | R | 1.4 | 0.55 | 0.98 | 8.2 | 0.60 | 2.6 | 2.9 | 0.84 | 1.4 | | | |
| | | T | 0.26 | 0.12 | 0.18 | 0.21 | 0.16 | 0.19 | 0.17 | 0.09 | 0.12 | | | |
| | Colour (TCU) | R | 3 | 1 | 2 | 10 | 2 | 3 | 5 | 2 | 3 | | | |
| | | T | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | | 3 | 3 | 3.0 | 10 | 3 | 4.6 | 3 | 2 | 2.9 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. (2) Al/Fe (mg/L) | R | | | 0.042 | 0.28 | 0.166 | 0.227 | 0.085 | 0.018 | 0.048 | | | |
| | | T | 0.193 | 0.044 | 0.108 | 0.178 | 0.057 | 0.129 | 0.012 | 0.002 | 0.004 | | | |
| | pH | R | 8.3 | 8.0 | 8.2 | 8.4 | 8.1 | 8.2 | 8.2 | 8.0 | 8.1 | | | |
| | | T | 7.7 | 7.3 | 7.6 | 7.8 | 7.4 | 7.6 | 7.6 | 7.3 | 7.4 | | | |
| | Temperature (°C) | R | 5.0 | 2.5 | 3.7 | 5.0 | 2.5 | 3.5 | 5.0 | 1.5 | 3.0 | | | |

R = Raw; T = Treated
(1) 1986 & 1985 - alum, 1984 - Ferric Chloride
(2) 1986 & 1985 - Al, 1984 - Fe
Raw-Total
Treated-Filtered

TABLE 2.0 (cont'd.)



| MONTH | PARAMETER | | | 1986 MAX. | 1986 MIN. | 1986 AVG. | 1985 MAX. | 1985 MIN. | 1985 AVG. | 1984 MAX. | 1984 MIN. | 1984 AVG. | MAX. | MIN. | AVG. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MAY | Turbidity (FTU) | | R | 1.8 | 0.53 | 0.88 | 1.7 | 0.71 | 1.1 | 1.5 | 0.47 | 0.87 | | | |
| | | | T | 0.27 | 0.20 | 0.24 | 0.33 | 0.19 | 0.27 | 0.23 | 0.08 | 0.13 | | | |
| | Colour (TCU) | | R | 4 | 2 | 2 | 3 | 2 | 2 | 4 | 2 | 3 | | | |
| | | | T | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | | | |
| | Prime Coagulant (1) | (mg/L) | | 3 | 3 | 3.3 | 5 | 3 | 4.3 | 3/2 | 3/2 | 6.5/2.4 | | | |
| | Coagulant Aid | (mg/L) | | | | | | | | | | | | | |
| | (1) | (mg/L) | | | | | | | | | | | | | |
| | (2) | (mg/L) | | | | | | | | | | | | | |
| | (3) | (mg/L) | | | | | | | | | | | | | |
| | (4) | (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al | (mg/L) | R | | | 0.038 | 0.32 | 0.021 | 0.152 | 0.007 | 0.003 | 0.005 | | | |
| | | | T | 0.218 | 0.081 | 0.134 | 0.202 | 0.068 | 0.140 | 0.079 | 0.026 | 0.045 | | | |
| | pH | | R | 8.4 | 8.1 | 8.2 | 8.5 | 8.2 | 8.3 | 8.3 | 8.1 | 8.2 | | | |
| | | | T | 7.8 | 7.5 | 7.7 | 7.8 | 7.4 | 7.6 | 7.8 | 7.4 | 7.5 | | | |
| | Temperature | (°C) | R | 8.5 | 3.5 | 5.6 | 8.0 | 4.0 | 5.3 | 6.0 | 3.5 | 4.6 | | | |
| JUN | Turbidity (FTU) | | R | 1.2 | 0.46 | 0.82 | 1.4 | 0.84 | 1.0 | 1.2 | 0.74 | 0.97 | | | |
| | | | T | 0.27 | 0.11 | 0.18 | 0.30 | 0.23 | 0.26 | 0.14 | 0.11 | 0.12 | | | |
| | Colour (TCU) | | R | 3 | 2 | 2 | 3 | 2 | 3 | 4 | 2 | 2 | | | |
| | | | T | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | | | |
| | Prime Coagulant (1) | (mg/L) | | 3 | 3 | 3.2 | 5 | 3 | 4.0 | 5/2 | 3/2 | 5.2/2.7 | | | |
| | Coagulant Aid | (mg/L) | | | | | | | | | | | | | |
| | (1) | (mg/L) | | | | | | | | | | | | | |
| | (2) | (mg/L) | | | | | | | | | | | | | |
| | (3) | (mg/L) | | | | | | | | | | | | | |
| | (4) | (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al | (mg/L) | R | | | 0.016 | 0.113 | 0.024 | 0.016 | 0.061 | 0.004 | 0.027 | | | |
| | | | T | 0.170 | 0.066 | 0.102 | 0.188 | 0.094 | 0.144 | 0.154 | 0.039 | 0.078 | | | |
| | pH | | R | 8.5 | 7.9 | 8.2 | 8.4 | 8.1 | 8.2 | 8.4 | 8.1 | 8.2 | | | |
| | | | T | 7.6 | 7.4 | 7.5 | 7.6 | 7.6 | 7.5 | 7.8 | 7.4 | 7.6 | | | |
| | Temperature | (°C) | R | 10.5 | 4.5 | 6.4 | 7.0 | 4.0 | 5.5 | 12.5 | 4.5 | 5.5 | | | |

R = Raw; T = Treated

(1) 1986 & 1985 - Alum, 1984 - Alum/Ferric Chloride
(2) 1986 & 1985 - Al, 1984 - Fe
Raw-Total; Treated-Filtered

TABLE 2.0 (cont'd.)



| MONTH | PARAMETER | | 1986 MAX. | 1986 MIN. | 1986 AVG. | 1985 MAX. | 1985 MIN. | 1985 AVG. | 1984 MAX. | 1984 MIN. | 1984 AVG. | MAX. | MIN. | AVG. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JUL | Turbidity (FTU) | R | 1.6 | 0.66 | 0.98 | 1.6 | 0.68 | 1.2 | 1.3 | 0.84 | 1.1 | | | |
| | | T | 0.36 | 0.13 | 0.21 | 0.29 | 0.19 | 0.24 | 0.18 | 0.11 | 0.13 | | | |
| | Colour (TCU) | R | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | | | |
| | | T | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | | 3 | 3 | 3.3 | 5 | 3 | 4.1 | 3 | 3 | 5.2 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al (2) (mg/L) | R | | | 0.067 | 0.121 | 0.022 | 0.070 | 0.180 | 0.030 | 0.040 | | | |
| | | T | 0.353 | 0.065 | 0.147 | 0.165 | 0.096 | 0.131 | | | 0.088 | | | |
| | pH | R | 8.5 | 8.0 | 8.2 | 8.4 | 8.1 | 8.3 | 8.4 | 8.1 | 8.2 | | | |
| | | T | 7.6 | 7.3 | 7.5 | 7.8 | 7.4 | 7.6 | 7.7 | 7.4 | 7.5 | | | |
| | Temperature (°C) | R | 16.0 | 5.0 | 9.8 | 14.5 | 5.0 | 7.1 | 14.5 | 3.5 | 6.0 | | | |
| AUG | Turbidity (FTU) | R | 3.8 | 0.75 | 1.3 | 2.4 | 0.55 | 1.2 | 3.0 | 0.96 | 1.5 | | | |
| | | T | 0.29 | 0.13 | 0.19 | 0.31 | 0.19 | 0.23 | 0.23 | 0.10 | 0.14 | | | |
| | Colour (TCU) | R | 4 | 2 | 3 | 4 | 2 | 3 | 4 | 2 | 2 | | | |
| | | T | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | R | 5 | 2 | 3.7 | 7 | 3 | 3.7 | 3 | 3 | 6.4 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al (2) (mg/L) | R | | | 0.049 | 0.128 | 0.044 | 0.071 | 0.545 | 0.042 | 0.007 | | | |
| | | T | 0.334 | 0.030 | 0.120 | 0.248 | 0.075 | 0.148 | | | 0.131 | | | |
| | pH | R | 8.0 | 7.8 | 7.9 | 8.5 | 7.9 | 8.2 | 8.5 | 8.0 | 8.1 | | | |
| | | T | 7.5 | 7.3 | 7.4 | 7.5 | 7.3 | 7.4 | 7.6 | 7.4 | 7.5 | | | |
| | Temperature (°C) | R | 20.5 | 6.0 | 11.4 | 19.5 | 7.0 | 15.7 | 20.5 | 5.0 | 11.9 | | | |

R = Raw; T = Treated
(1) Alum
(2) Raw-Total
Treated-Filtered (1986, 1985) Total (1984)

TABLE 2.0 (cont'd.)



| MONTH | PARAMETER | | 1986 MAX. | 1986 MIN. | 1986 AVG. | 1985 MAX. | 1985 MIN. | 1985 AVG. | 1984 MAX. | 1984 MIN. | 1984 AVG. | MAX. | MIN. | AVG. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SEP | Turbidity (FTU) | R | 2.7 | 0.68 | 1.1 | 2.1 | 0.64 | 1.2 | 3.3 | 0.59 | 1.2 | | | |
| | | T | 0.27 | 0.12 | 0.20 | 0.31 | 0.19 | 0.22 | 0.22 | 0.09 | 0.17 | | | |
| | Colour (TCU) | R | 3 | 1 | 2 | 3 | 2 | 2 | 4 | 2 | 3 | | | |
| | | T | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | | 5/1 | 3/0.8 | 3.6/0.93 | 7 | 3 | 4.7 | 5 | 3 | 4.5 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al (mg/L) | R | | | 0.034 | 0.480 | 0.027 | 0.149 | | | 0.010 | | | |
| | | T | 0.185 | 0.035 | 0.104 | 0.208 | 0.073 | 0.136 | 0.186 | 0.046 | 0.106 | | | |
| | pH | R | 8.3 | 7.9 | 8.1 | 8.5 | 7.9 | 8.2 | 8.3 | 7.9 | 8.1 | | | |
| | | T | 7.7 | 7.5 | 7.6 | 7.6 | 7.4 | 7.5 | 7.6 | 7.3 | 7.5 | | | |
| | Temperature (°C) | R | 17.0 | 5.0 | 10.7 | 20.0 | 6.5 | 15.3 | 18.0 | 4.5 | 10.5 | | | |
| OCT | Turbidity (FTU) | R | 1.2 | 0.54 | 0.88 | 1.7 | 0.44 | 0.78 | 2.2 | 0.54 | 0.87 | | | |
| | | T | 0.28 | 0.15 | 0.20 | 0.21 | 0.11 | 0.16 | 0.29 | 0.15 | 0.22 | | | |
| | Colour (TCU) | R | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | | | |
| | | T | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | Prime Coagulant (2) (mg/L) | | 1 | 0.6 | 0.69 | 4 | 3 | 3.6 | 5 | 3 | 4.0 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al (mg/L) | R | | | 0.034 | 0.035 | 0.013 | 0.025 | | | 0.042 | | | |
| | | T | 0.149 | 0.029 | 0.067 | 0.236 | 0.052 | 0.121 | 0.182 | 0.045 | 0.107 | | | |
| | pH | R | 8.2 | 7.9 | 8.1 | 8.3 | 7.8 | 8.1 | 8.0 | 8.2 | 8.2 | | | |
| | | T | 7.7 | 7.4 | 7.6 | 7.7 | 7.4 | 7.5 | 7.8 | 7.4 | 7.6 | | | |
| | Temperature (°C) | R | 15.0 | 4.5 | 9.4 | 15.0 | 4.5 | 8.7 | 12.5 | 5.5 | 9.9 | | | |

R = Raw; T = Treated

(1) Alum/PACl (polyaluminum chloride)

(2) 1986 - PACl, 1985 & 1984 - Alum

Raw-Total; Treated-Filtered (1986, 1985) Total (1984)

TABLE 2.0 (cont'd.)



| MONTH | PARAMETER | | 1986 | | | 1985 | | | 1984 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | MAX. | MIN. | AVG. | MAX. | MIN. | AVG. | MAX. | MIN. | AVG. | MAX. | MIN. | AVG. |
| NOV | Turbidity (FTU) | R | 2.4 | 0.61 | 1.0 | 4.8 | 0.79 | 1.9 | 2.4 | 0.61 | 1.2 | | | |
| | | T | 0.26 | 0.10 | 0.16 | 0.32 | 0.12 | 0.22 | 0.31 | 0.16 | 0.20 | | | |
| | Colour (TCU) | R | 3 | 2 | 2 | 4 | 2 | 2 | 3 | 2 | 2 | | | |
| | | T | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | | 1 | 0.6 | 0.65 | 5 | 3 | 3.4 | 5 | 3 | 3.0 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al (mg/L) | R | | | 0.075 | 0.015 | 0.022 | 0.060 | 0.161 | 0.115 | 0.138 | | | |
| | | T | 0.080 | 0.031 | 0.052 | 0.199 | 0.077 | 0.132 | 0.162 | 0.041 | 0.091 | | | |
| | pH | R | 8.3 | 7.9 | 8.0 | 8.2 | 7.9 | 8.1 | 8.3 | 8.0 | 8.2 | | | |
| | | T | 7.7 | 7.4 | 7.6 | 7.7 | 7.4 | 7.5 | 7.7 | 7.4 | 7.6 | | | |
| | Temperature (°C) | R | 9.0 | 4.0 | 5.8 | 11.5 | 5.0 | 8.4 | 12.0 | 4.5 | 6.9 | | | |
| DEC | Turbidity (FTU) | R | 3.7 | 0.73 | 1.4 | 3.2 | 0.91 | 1.6 | 4.9 | 0.64 | 1.9 | | | |
| | | T | 0.20 | 0.12 | 0.16 | 0.28 | 0.13 | 0.21 | 0.19 | 0.13 | 0.15 | | | |
| | Colour (TCU) | R | 2 | 2 | 2 | 3 | 2 | 2 | 10 | 3 | 3 | | | |
| | | T | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | | | |
| | Prime Coagulant (1) (mg/L) | | 1 | 0.6 | 0.63 | 5 | 3 | 2.7 | 5 | 3 | 3.7 | | | |
| | Coagulant Aid (mg/L) | | | | | | | | | | | | | |
| | (1) (mg/L) | | | | | | | | | | | | | |
| | (2) (mg/L) | | | | | | | | | | | | | |
| | (3) (mg/L) | | | | | | | | | | | | | |
| | (4) (mg/L) | | | | | | | | | | | | | |
| | Metal Res. Al (mg/L) | R | | | 0.111 | 0.105 | 0.037 | 0.080 | | | 0.098 | | | |
| | | T | 0.110 | 0.024 | 0.050 | 0.148 | 0.058 | 0.099 | 0.113 | 0.042 | 0.075 | | | |
| | pH | R | 8.2 | 7.8 | 8.1 | 8.2 | 8.0 | 8.1 | 8.2 | 8.0 | 8.1 | | | |
| | | T | 7.7 | 7.4 | 7.5 | 7.7 | 7.4 | 7.6 | 7.7 | 7.5 | 7.6 | | | |
| | Temperature (°C) | R | 5.5 | 3.0 | 3.7 | 7.5 | 3.0 | 5.0 | 5.0 | 3.0 | 4.0 | | | |

R - Raw; T - Treated
(1) 1986 PACl, 1985 & 1984 - Alum
(2) Raw-Total
Treated-Filtered (1986, 1985) Total (1984)

# TABLE 2.1 PARTICULATE REMOVAL PROFILE JANUARY 1986



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al (mg/L) | | pH | | TEMP. ($^oC$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 1.6 | | 0.10 | 0.11 | | | 3/2 | | | | | | | 0.082 | | | 4.0 |
| 2 | 2.8 | | 0.19 | 0.12 | 2 | 1 | 5/3 | | | | | | | 0.076 | | | 3.8 |
| 3 | 3.2 | | 0.31 | 0.19 | 3 | 1 | 5/3 | | | | | | | 0.065 | | | 3.4 |
| 4 | 1.7 | | 0.28 | 0.20 | | | 3 | | | | | | | 0.064 | | | 2.9 |
| 5 | 1.7 | | 0.17 | 0.14 | | | 3 | | | | | | | 0.065 | | | 2.5 |
| 6 | 2.4 | | 0.16 | 0.10 | 2 | 1 | 5/3 | | | | | | | 0.080 | 8.1 | 7.6 | 2.4 |
| 7 | 2.1 | | 0.14 | 0.11 | 2 | 1 | 3 | | | | | | 0.122 | 0.093 | 8.1 | 7.6 | 2.8 |
| 8 | 1.3 | | 0.18 | 0.11 | 2 | 1 | 3 | | | | | | | 0.122 | 8.1 | 7.7 | 3.0 |
| 9 | 2.2 | | 0.19 | 0.16 | 3 | 1 | 3 | | | | | | | 0.072 | 8.1 | 7.7 | 3.7 |
| 10 | 2.7 | | 0.26 | 0.19 | 2 | 1 | 3 | | | | | | | 0.092 | 8.1 | 7.6 | 3.3 |
| 11 | 2.0 | | 0.21 | 0.14 | | | 3 | | | | | | | 0.080 | | | 2.8 |
| 12 | 2.2 | | 0.17 | 0.14 | | | 3 | | | | | | | 0.069 | | | 3.6 |
| 13 | 1.8 | | 0.21 | 0.16 | 3 | 1 | 3 | | | | | | | 0.069 | 8.1 | 7.5 | 3.3 |
| 14 | 1.6 | | 0.20 | 0.19 | 2 | 1 | 3 | | | | | | | 0.069 | 8.1 | 7.6 | 3.0 |
| 15 | 1.5 | | 0.23 | 0.17 | 2 | 1 | 3 | | | | | | | 0.069 | 8.1 | 7.6 | 3.5 |

* Alum - max/min
- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1(cont'd.) JANUARY 1986

| DATE | TURBIDITY (FTU) Raw | Set. | Filter | Treat. | COLOUR (TCU) Raw | Treat. | COAGULANT* mg/L | COAG. AID mg/L | (1) mg/L | (2) mg/L | (3) mg/L | (4) mg/L | METAL RES. (1) Al (mg/L) Raw | Treat. | pH Raw | Treat. | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 0.98 | | 0.21 | 0.17 | 4 | 1 | 3 | | | | | | | 0.100 | 8.1 | 7.7 | 2.7 |
| 17 | 0.99 | | 0.21 | 0.20 | 2 | 1 | 3 | | | | | | | 0.107 | 8.1 | 7.7 | 3.3 |
| 18 | 0.94 | | 0.20 | 0.20 | | | 3 | | | | | | | 0.100 | | | 3.3 |
| 19 | 0.92 | | 0.21 | 0.22 | | | 3 | | | | | | | 0.130 | | | 3.5 |
| 20 | 0.79 | | 0.17 | 0.19 | 2 | 1 | 3/2 | | | | | | | 0.090 | 8.1 | 7.5 | 3.7 |
| 21 | 2.6 | | 0.22 | 0.15 | 3 | 1 | 5/3 | | | | | | | 0.094 | 8.1 | 7.5 | 3.6 |
| 22 | 1.9 | | 0.18 | 0.14 | 3 | 1 | 3 | | | | | | | 0.098 | 8.1 | 7.6 | 4.0 |
| 23 | 0.85 | | 0.22 | 0.16 | 2 | 1 | 3 | | | | | | | 0.095 | 8.1 | 7.6 | 4.0 |
| 24 | 0.82 | | 0.10 | 0.12 | 2 | 1 | 2 | | | | | | | 0.091 | | | 3.6 |
| 25 | 4.8 | | 0.15 | 0.14 | | | 5/3 | | | | | | | 0.094 | | | 3.4 |
| 26 | 2.1 | | 0.15 | 0.15 | | | 5/3 | | | | | | | 0.097 | | | 3.4 |
| 27 | 2.1 | | 0.24 | 0.17 | 3 | 1 | 3 | | | | | | | 0.107 | 8.1 | 7.6 | 3.4 |
| 28 | 1.5 | | 0.19 | 0.14 | 2 | 1 | 3 | | | | | | | 0.107 | 8.1 | 7.6 | 3.2 |
| 29 | 1.8 | | 0.23 | 0.21 | 2 | 1 | 5/3 | | | | | | | 0.086 | 8.2 | 7.6 | 2.8 |
| 30 | 0.84 | | 0.13 | 0.14 | 2 | 1 | 3 | | | | | | | 0.085 | 8.1 | 7.6 | 3.7 |
| 31 | 1.5 | | 0.19 | 0.13 | 2 | 1 | 3 | | | | | | | 0.070 | 8.1 | 7.6 | 3.3 |

* Alum - max/min
 - avg.

(1) Raw-Total
 Treated-Filtered

# TABLE 2.1 PARTICULATE REMOVAL PROFILE APRIL 1986

WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 1.1 | | 0.13 | 0.14 | 2 | 1 | 3 | | | | | | | 0.068 | 8.1 | 7.6 | 3.4 |
| 2 | 1.2 | | 0.08 | 0.12 | 2 | 1 | 3 | | | | | | 0.042 | 0.057 | 8.1 | 7.5 | 3.2 |
| 3 | 1.4 | | 0.09 | 0.14 | 3 | 1 | 3 | | | | | | | 0.044 | 8.0 | 7.3 | 3.5 |
| 4 | 1.2 | | 0.09 | 0.15 | 2 | 1 | 3 | | | | | | | 0.053 | 8.1 | 7.4 | 3.4 |
| 5 | 1.2 | | 0.14 | 0.17 | | | 3 | | | | | | | 0.051 | | | 3.7 |
| 6 | 1.4 | | 0.19 | 0.18 | | | 3 | | | | | | | 0.048 | | | 3.6 |
| 7 | 0.96 | | 0.10 | 0.17 | 2 | 1 | 3 | | | | | | | 0.101 | 8.1 | 7.5 | 3.5 |
| 8 | 0.99 | | 0.17 | 0.20 | 2 | 1 | 3 | | | | | | | 0.059 | 8.2 | 7.6 | 3.6 |
| 9 | 1.2 | | 0.18 | 0.18 | 2 | 1 | 3 | | | | | | | 0.064 | 8.0 | 7.6 | 3.6 |
| 10 | 0.87 | | 0.12 | 0.12 | 2 | 1 | 3 | | | | | | | 0.063 | 8.1 | 7.5 | 3.4 |
| 11 | 1.0 | | 0.16 | 0.22 | 2 | 1 | 3 | | | | | | | 0.144 | 8.0 | 7.5 | 3.1 |
| 12 | 0.55 | | 0.12 | 0.16 | | | 3 | | | | | | | 0.132 | | | 2.7 |
| 13 | 0.56 | | 0.10 | 0.16 | | | 3 | | | | | | | 0.172 | | | 2.9 |
| 14 | 1.1 | | 0.13 | 0.19 | 3 | 1 | 3 | | | | | | | 0.193 | 8.0 | 7.5 | 3.2 |
| 15 | 0.84 | | 0.10 | 0.18 | 2 | 1 | 3 | | | | | | | 0.120 | 8.1 | 7.5 | 3.3 |

* Alum - max./min.
- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1(cont'd.) APRIL 1986

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Al (mg/L)(1) | | pH | | TEMP. ($^{o}C$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 0.98 | | 0.11 | 0.17 | 2 | 1 | 3 | | | | | | | 0.136 | 8.2 | 7.5 | 3.5 |
| 17 | 0.79 | | 0.09 | 0.15 | 2 | 1 | 3 | | | | | | | 0.113 | 8.1 | 7.7 | 3.4 |
| 18 | 1.2 | | 0.14 | 0.19 | 2 | 1 | 3 | | | | | | | 0.161 | 8.3 | 7.7 | 4.1 |
| 19 | 1.0 | | 0.10 | 0.17 | | | 3 | | | | | | | 0.146 | | | 4.1 |
| 20 | 1.1 | | 0.16 | 0.15 | | | 3 | | | | | | | 0.166 | | | 4.0 |
| 21 | 0.70 | | 0.14 | 0.21 | 3 | 1 | 3 | | | | | | | 0.162 | 8.2 | 7.7 | 4.0 |
| 22 | 0.73 | | 0.14 | 0.16 | 2 | 1 | 3 | | | | | | | 0.182 | 8.3 | 7.6 | 4.2 |
| 23 | 0.61 | | 0.11 | 0.16 | 2 | 1 | 3 | | | | | | | 0.095 | 8.2 | 7.7 | 3.7 |
| 24 | 0.73 | | 0.14 | 0.17 | 2 | 1 | 3 | | | | | | | 0.107 | 8.2 | 7.7 | 3.8 |
| 25 | 1.2 | | 0.20 | 0.23 | 2 | 1 | 3 | | | | | | | 0.101 | 8.3 | 7.7 | 4.6 |
| 26 | 1.3 | | 0.18 | 0.26 | | | 3 | | | | | | | 0.115 | | | 4.5 |
| 27 | 0.88 | | 0.10 | 0.23 | | | 3 | | | | | | | 0.084 | | | 4.0 |
| 28 | 0.79 | | 0.13 | 0.24 | 2 | 1 | 3 | | | | | | | 0.082 | 8.2 | 7.6 | 3.8 |
| 29 | 0.83 | | 0.14 | 0.24 | 1 | 1 | 3 | | | | | | | 0.099 | 8.2 | 7.5 | 4.4 |
| 30 | 0.97 | | 0.16 | 0.24 | 2 | 1 | 3 | | | | | | | 0.115 | 8.3 | 7.7 | 4.6 |
| 31 | | | | | | | | | | | | | | | | | |

* Alum - max./min.
 - avg.

(1) Raw-Total
 Treated-Filtered

TABLE 2.1 PARTICULATE REMOVAL PROFILE JULY 1986



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Al (mg/L) (1) | | pH | | TEMP. ($^oC$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 1.2 | | 0.09 | 0.14 | | | 3 | | | | | | | 0.176 | 8.2 | | 5.8 |
| 2 | 1.0 | | 0.13 | 0.18 | 3 | 1 | 3 | | | | | | | 0.189 | 8.2 | 7.5 | 5.2 |
| 3 | 1.2 | | 0.12 | 0.16 | 3 | 1 | 3 | | | | | | | 0.179 | 8.2 | 7.5 | 5.7 |
| 4 | 1.0 | | 0.12 | 0.16 | 2 | 1 | 3 | | | | | | | 0.201 | 8.2 | 7.5 | 5.8 |
| 5 | 1.2 | | 0.11 | 0.16 | | | 3 | | | | | | | 0.180 | 8.2 | | 5.3 |
| 6 | 1.2 | | 0.12 | 0.15 | | | 3 | | | | | | | 0.105 | 8.2 | | 5.1 |
| 7 | 0.93 | | 0.11 | 0.14 | 2 | 1 | 3 | | | | | | 0.067 | 0.177 | 8.2 | 7.5 | 5.2 |
| 8 | 0.66 | | 0.11 | 0.13 | 2 | 1 | 3 | | | | | | | 0.182 | 8.2 | 7.4 | 5.2 |
| 9 | 0.99 | | 0.12 | 0.13 | 2 | 1 | 3 | | | | | | | 0.179 | 8.2 | 7.4 | 5.3 |
| 10 | 1.2 | | 0.12 | 0.15 | 3 | 1 | 3 | | | | | | | 0.189 | 8.2 | 7.4 | 5.9 |
| 11 | 1.1 | | 0.13 | 0.14 | 2 | 1 | 3 | | | | | | | 0.096 | 8.2 | 7.5 | 6.1 |
| 12 | 1.6 | | 0.16 | 0.16 | | | 3 | | | | | | | 0.240 | 8.4 | | 8.6 |
| 13 | 1.2 | | 0.18 | 0.18 | | | 3 | | | | | | | 0.168 | 8.4 | | 9.2 |
| 14 | 0.86 | | 0.23 | 0.20 | 2 | 1 | 3 | | | | | | | 0.117 | 8.4 | 7.5 | 9.8 |
| 15 | 0.86 | | 0.24 | 0.21 | 3 | 1 | 3 | | | | | | | 0.157 | 8.4 | 7.6 | 11.2 |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1(cont'd.)

JULY 1986



| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 1.2 | | 0.24 | 0.22 | 2 | 1 | 3 | | | | | | | 0.084 | 8.4 | 7.5 | 12.9 |
| 17 | 1.0 | | 0.25 | 0.24 | 2 | 1 | 3 | | | | | | | 0.353 | 8.4 | 7.6 | 12.4 |
| 18 | 0.86 | | 0.25 | 0.23 | 3 | 1 | 3 | | | | | | | 0.126 | 8.4 | 7.6 | 12.3 |
| 19 | 0.80 | | 0.17 | 0.34 | | | 3 | | | | | | | 0.090 | 8.4 | | 13.8 |
| 20 | 0.83 | | 0.19 | 0.36 | | | 3 | | | | | | | 0.090 | | | 14.9 |
| 21 | 0.80 | | 0.16 | 0.30 | 3 | 1 | 3 | | | | | | | 0.141 | 8.3 | 7.4 | 11.7 |
| 22 | 0.84 | | 0.21 | 0.26 | 3 | 1 | 3 | | | | | | | 0.065 | 8.3 | 7.4 | 11.9 |
| 23 | 0.87 | | 0.20 | 0.24 | 3 | 1 | 3 | | | | | | | 0.087 | 8.3 | 7.4 | 12.9 |
| 24 | 1.2 | | 0.13 | 0.23 | 3 | 1 | 3 | | | | | | | 0.101 | 8.2 | 7.4 | 13.1 |
| 25 | 0.83 | | 0.11 | 0.26 | 2 | 1 | 3 | | | | | | | 0.072 | 8.2 | 7.4 | 12.2 |
| 26 | 0.76 | | 0.13 | 0.24 | | | 3 | | | | | | | 0.098 | 8.1 | | 12.0 |
| 27 | 0.78 | | 0.18 | 0.22 | | | 3 | | | | | | | 0.162 | 8.1 | | 12.4 |
| 28 | 0.80 | | 0.16 | 0.22 | 2 | 1 | # | | | | | | | 0.129 | 8.1 | 7.4 | 12.7 |
| 29 | 0.79 | | 0.18 | 0.21 | 2 | 1 | 3 | | | | | | | 0.124 | 8.1 | 7.4 | 12.5 |
| 30 | 0.74 | | 0.13 | 0.31 | 3 | 1 | 3 | | | | | | | 0.188 | 8.0 | 7.4 | 11.2 |
| 31 | 1.0 | | 0.14 | 0.26 | 2 | 1 | 3 | | | | | | | 0.118 | 8.1 | 7.3 | 11.2 |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Filtered

# TABLE 2.1 PARTICULATE REMOVAL PROFILE

OCTOBER 1986

WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | PAC COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 0.54 | | 0.16 | 0.19 | 2 | 1 | 1 | | | | | | | 0.055 | 8.1 | 7.5 | 14.8 |
| 2 | 0.71 | | 0.18 | 0.19 | 2 | 1 | 1 | | | | | | | 0.108 | 8.1 | 7.5 | 14.6 |
| 3 | 0.77 | | 0.22 | 0.21 | 2 | 1 | 1/0.8 | | | | | | | 0.069 | 8.1 | 7.5 | 14.6 |
| 4 | 1.2 | | 0.24 | 0.24 | | | 0.8 | | | | | | | 0.078 | 8.0 | | 14.7 |
| 5 | 1.0 | | 0.23 | 0.24 | | | 0.8 | | | | | | | 0.149 | 8.0 | | 14.7 |
| 6 | 1.1 | | 0.13 | 0.18 | 2 | 1 | 0.8/0.6 | | | | | | | 0.100 | 7.9 | 7.6 | 11.4 |
| 7 | 1.2 | | 0.14 | 0.20 | 3 | 1 | 0.8/0.6 | | | | | | 0.034 | 0.087 | 8.1 | 7.6 | |
| 8 | 1.0 | | 0.10 | 0.16 | 3 | 1 | 0.6 | | | | | | | 0.062 | 8.0 | 7.4 | 6.3 |
| 9 | 0.91 | | 0.11 | 0.16 | 2 | 1 | 0.6 | | | | | | | 0.117 | 8.0 | 7.5 | 6.2 |
| 10 | 0.82 | | 0.09 | 0.15 | 2 | 1 | 0.7 | | | | | | | 0.113 | 8.0 | 7.5 | 7.1 |
| 11 | 0.95 | | 0.11 | 0.17 | | | 0.7 | | | | | | | 0.054 | 8.0 | | 6.1 |
| 12 | 0.92 | | 0.11 | 0.15 | | | 0.7 | | | | | | | 0.051 | 8.0 | | 7.5 |
| 13 | 0.83 | | 0.11 | 0.18 | | | 0.7 | | | | | | | 0.065 | 8.1 | | 10.4 |
| 14 | 0.84 | | 0.14 | 0.19 | 2 | 2 | 0.7/0.6 | | | | | | | 0.074 | 8.1 | 7.6 | 9.5 |
| 15 | 0.81 | | 0.12 | 0.18 | 2 | 1 | 0.7 | | | | | | | 0.061 | 8.1 | 7.6 | 8.4 |

* Polyaluminum Chloride (PACl) - max./min.

\- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1(cont'd.)

OCTOBER 1986

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (mg/L)(1) | | pH | | TEMP. ($^{o}C$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Al Raw | Treat. | Raw | Treat. | |
| 16 | 0.90 | | 0.09 | 0.17 | 2 | 1 | 0.7 | | | | | | | 0.067 | 7.9 | 7.7 | 7.4 |
| 17 | 0.70 | | 0.10 | 0.17 | 2 | 1 | 0.7/0.6 | | | | | | | 0.060 | 8.1 | 7.7 | 7.2 |
| 18 | 0.61 | | 0.13 | 0.18 | | | 0.7/0.6 | | | | | | | 0.032 | | | 7.2 |
| 19 | 0.93 | | 0.12 | 0.18 | | | 0.7/0.6 | | | | | | | 0.034 | | | 7.9 |
| 20 | 1.1 | | 0.13 | 0.17 | 2 | 1 | 0.7/0.6 | | | | | | | 0.040 | 8.0 | 7.6 | 8.0 |
| 21 | 0.81 | | 0.12 | 0.18 | 2 | 1 | 0.7/0.6 | | | | | | | 0.036 | 8.1 | 7.6 | 8.0 |
| 22 | 0.84 | | 0.12 | 0.18 | 2 | 1 | 0.7/0.6 | | | | | | | 0.029 | 8.0 | 7.6 | 8.0 |
| 23 | 0.78 | | 0.11 | 0.18 | 2 | 1 | 0.7/0.6 | | | | | | | 0.060 | 8.1 | 7.6 | 7.7 |
| 24 | 0.91 | | 0.13 | 0.17 | 2 | 1 | 0.7/0.6 | | | | | | | 0.045 | 8.0 | 7.6 | 7.9 |
| 25 | 1.0 | | 0.15 | 0.21 | | | 0.7/0.6 | | | | | | | 0.075 | | | 8.6 |
| 26 | 1.0 | | 0.22 | 0.26 | | | 0.7/0.6 | | | | | | | 0.054 | | | 9.8 |
| 27 | 0.77 | | 0.22 | 0.28 | 2 | 1 | 0.7/0.6 | | | | | | | 0.062 | 8.2 | 7.6 | 10.0 |
| 28 | 0.92 | | 0.23 | 0.28 | 2 | 1 | 0.7/0.6 | | | | | | | 0.063 | 8.2 | 7.7 | 9.0 |
| 29 | 0.78 | | 0.20 | 0.27 | 2 | 1 | 0.7/0.6 | | | | | | | 0.056 | 8.2 | 7.7 | 9.0 |
| 30 | 0.75 | | 0.19 | 0.25 | 2 | 1 | 0.7/0.6 | | | | | | | 0.083 | 8.1 | 7.7 | 10.0 |
| 31 | 0.93 | | 0.27 | 0.26 | 2 | 1 | 0.7/0.6 | | | | | | | 0.047 | 8.1 | 7.6 | 9.0 |

* Polyaluminum Chloride (PACl) - max./min.

\- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1 PARTICULATE REMOVAL PROFILE JANUARY 1985



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Al/Fe (mg/L) (1) | | pH | | TEMP. ($^0$C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 3.8 | | 0.09 | 0.15 | | | 5/3 | | | | | | | 0.073 | | | 3.5 |
| 2 | 3.6 | | 0.13 | 0.15 | 5 | 1 | 5/3 | | | | | | | 0.067 | 8.2 | 7.6 | 3.4 |
| 3 | 1.7 | | 0.12 | 0.16 | 5 | 1 | 3 | | | | | | | 0.070 | 8.1 | 7.5 | 3.3 |
| 4 | 1.2 | | 0.12 | 0.15 | 3 | 1 | 3 | | | | | | | 0.066 | 8.1 | 7.6 | 3.0 |
| 5 | 0.87 | | 0.10 | 0.15 | | | 3 | | | | | | | 0.073 | | | 3.0 |
| 6 | 1.3 | | 0.10 | 0.14 | | | 3 | | | | | | | 0.295 | | | 3.2 |
| 7 | 3.8 | | 0.10 | 0.15 | 4 | 1 | 3 | | | | | | | 0.103 | 8.1 | 7.6 | 2.8 |
| 8 | 2.6 | | 0.11 | 0.15 | 3 | 1 | 3 | | | | | | 0.178 | 0.120 | 8.2 | 7.7 | 2.5 |
| 9 | 1.0 | | 0.09 | 0.15 | 4 | 1 | 3 | | | | | | | 0.062 | 8.1 | 7.6 | 2.5 |
| 10 | 1.1 | | 0.10 | 0.15 | 3 | 1 | 3 | | | | | | | 0.071 | 8.2 | 7.7 | 2.1 |
| 11 | 0.88 | | 0.09 | 0.15 | 3 | 1 | 3 | | | | | | | 0.047 | 8.2 | 7.6 | 2.0 |
| 12 | 0.69 | | 0.08 | 0.15 | | | 3 | | | | | | | 0.065 | | | 2.6 |
| 13 | 0.81 | | 0.08 | 0.15 | | | 3 | | | | | | | 0.060 | | | 2.9 |
| 14 | 2.5 | | 0.09 | 0.15 | 2 | 1 | 3 | | | | | | | 0.045 | 8.2 | 7.6 | 3.1 |
| 15 | 1.2 | | 0.08 | 0.15 | 3 | 1 | 3 | | | | | | | 0.042 | 8.2 | 7.6 | 2.8 |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Total

TABLE 2.1(cont'd.)

JANUARY 1985



| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Al/Fe (mg/L)(1) | | pH | | TEMP. ($^oC$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 1.0 | | 0.08 | 0.15 | 3 | 1 | 3 | | | | | | | 0.051 | 8.2 | 7.7 | 2.3 |
| 17 | 2.1 | | 0.15 | 0.16 | 3 | 1 | 5/3 | | | | | | | 0.052 | 8.1 | 7.5 | 2.0 |
| 18 | 1.4 | | 0.14 | 0.17 | 2 | 1 | 5/3 | | | | | | | 0.064 | 8.2 | 7.6 | 2.1 |
| 19 | 1.0 | | 0.11 | 0.16 | | | 3 | | | | | | | 0.060 | | | 2.2 |
| 20 | 1.1 | | 0.12 | 0.16 | | | 3 | | | | | | | 0.062 | | | 2.1 |
| 21 | 2.5 | | 0.11 | 0.16 | 4 | 1 | 5/3 | | | | | | | 0.060 | 8.2 | 7.5 | 2.1 |
| 22 | 1.5 | | 0.11 | 0.16 | 3 | 1 | 3 | | | | | | | 0.045 | 8.1 | 7.6 | 2.0 |
| 23 | 1.1 | | 0.13 | 0.16 | 4 | 1 | 3 | | | | | | | 0.040 | 8.2 | 7.6 | 2.2 |
| 24 | 0.79 | | 0.12 | 0.16 | 4 | 1 | 3 | | | | | | | 0.035 | 8.1 | 7.7 | 2.5 |
| 25 | 0.86 | | 0.13 | 0.16 | 3 | 1 | 3 | | | | | | | 0.059 | 8.2 | 7.7 | 2.5 |
| 26 | 0.57 | | 0.08 | 0.16 | | | 3 | | | | | | | 0.058 | | | 2.2 |
| 27 | 0.89 | | 0.09 | 0.15 | | | 3 | | | | | | | 0.048 | | | 2.2 |
| 28 | 0.71 | | 0.11 | 0.16 | 2 | 1 | 3 | | | | | | | 0.055 | 8.1 | 7.6 | 2.5 |
| 29 | 0.64 | | 0.14 | 0.17 | 4 | 1 | 3 | | | | | | | 0.080 | 8.1 | 7.8 | 2.5 |
| 30 | 0.48 | | 0.12 | 0.16 | 2 | 1 | 3 | | | | | | | 0.181 | 8.1 | 7.6 | 2.2 |
| 31 | 1.3 | | 0.12 | 0.16 | 2 | 1 | 3 | | | | | | | 0.069 | 8.1 | 7.7 | 2.4 |

* Alum - max./min.

\- avg.

(1) Raw-Total
Treated-Total

## TABLE 2.1 PARTICULATE REMOVAL PROFILE      APRIL 1985



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Al (mg/L) (1) | | pH | | TEMP. ($^{o}C$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 5.7 | | 0.16 | 0.17 | 5 | 1 | 7/3 | | | | | | | 0.155 | 8.1 | 7.6 | 2.7 |
| 2 | 3.3 | | 0.11 | 0.17 | 3 | 1 | 5/3 | | | | | | 0.251 | 0.073 | 8.2 | 7.7 | 2.7 |
| 3 | 0.91 | | 0.09 | 0.17 | 3 | 1 | 3 | | | | | | | 0.072 | 8.1 | 7.6 | 2.5 |
| 4 | 0.60 | | 0.09 | 0.16 | 3 | 1 | 3 | | | | | | | 0.098 | 8.2 | 7.6 | 2.5 |
| 5 | 2.0 | | 0.11 | 0.17 | | | 3 | | | | | | | 0.102 | | | 2.5 |
| 6 | 2.8 | | 0.11 | 0.18 | | | 5/3 | | | | | | | 0.119 | | | 2.7 |
| 7 | 4.0 | | 0.12 | 0.17 | | | 5/3 | | | | | | | 0.078 | | | 2.8 |
| 8 | 6.2 | | 0.14 | 0.17 | | | 5 | | | | | | | 0.072 | | | 3.0 |
| 9 | 8.2 | | 0.19 | 0.18 | 10 | 1 | 10/5 | | | | | | | 0.092 | 8.1 | 7.4 | 3.0 |
| 10 | 4.3 | | 0.28 | 0.21 | 6 | 1 | 5/3 | | | | | | 0.260 | 0.102 | 8.1 | 7.4 | 2.9 |
| 11 | 1.5 | | 0.15 | 0.18 | 3 | 1 | 3 | | | | | | 0.166 | 0.082 | 8.1 | 7.5 | 2.8 |
| 12 | 2.7 | | 0.07 | 0.18 | 2 | 1 | 3 | | | | | | | 0.158 | 8.1 | 7.7 | 3.1 |
| 13 | 2.6 | | 0.09 | 0.19 | | | 3 | | | | | | | 0.157 | | | 3.1 |
| 14 | 4.3 | | 0.13 | 0.19 | | | 5/3 | | | | | | | 0.165 | | | 3.2 |
| 15 | 2.1 | | 0.17 | 0.19 | 3 | 1 | 3 | | | | | | | 0.079 | 8.2 | 7.5 | 3.3 |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1(cont'd)

APRIL 1985



| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al/Fe (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 1.8 | | 0.15 | 0.19 | 2 | 1 | 3 | | | | | | | 0.117 | 8.2 | 7.5 | 3.5 |
| 17 | 2.6 | | 0.21 | 0.19 | 2 | 1 | 5/3 | | | | | | | 0.173 | 8.2 | 7.6 | 3.6 |
| 18 | 1.8 | | 0.13 | 0.18 | 3 | 1 | 3 | | | | | | | 0.149 | 8.2 | 7.7 | 3.5 |
| 19 | 1.9 | | 0.17 | 0.19 | 3 | 1 | 3 | | | | | | | 0.133 | 8.2 | 7.7 | 3.9 |
| 20 | 1.4 | | 0.13 | 0.18 | | | 3 | | | | | | | 0.147 | | | 3.7 |
| 21 | 1.9 | | 0.17 | 0.19 | | | 3 | | | | | | | 0.149 | | | 4.0 |
| 22 | 2.2 | | 0.19 | 0.19 | 3 | 1 | 5/3 | | | | | | 0.280 | 0.152 | 8.2 | 7.8 | 4.0 |
| 23 | 1.7 | | 0.16 | 0.20 | 2 | 1 | 3 | | | | | | | 0.161 | 8.2 | 7.7 | 4.0 |
| 24 | 1.5 | | 0.14 | 0.19 | 2 | 1 | 3 | | | | | | | 0.171 | 8.2 | 7.7 | 4.2 |
| 25 | 1.5 | | 0.17 | 0.19 | 2 | 1 | 3 | | | | | | | 0.163 | 8.3 | 7.7 | 4.6 |
| 26 | 1.8 | | 0.23 | 0.20 | 3 | 1 | 3 | | | | | | | 0.177 | 8.3 | 7.6 | 4.7 |
| 27 | 1.6 | | 0.21 | 0.20 | | | 3 | | | | | | | 0.176 | | | 4.9 |
| 28 | 1.5 | | 0.16 | 0.20 | | | 3 | | | | | | | 0.057 | | | 4.7 |
| 29 | 2.0 | | 0.30 | 0.22 | 2 | 1 | 5/3 | | | | | | | 0.178 | 8.4 | 7.7 | 4.8 |
| 30 | 1.4 | | 0.14 | 0.21 | 2 | 1 | 3 | | | | | | 0.178 | 0.148 | 8.3 | 7.7 | 4.3 |
| 31 | | | | | | | | | | | | | | | | | |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1 PARTICULATE REMOVAL PROFILE JULY 1985 

WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 1.4 | | 0.23 | 0.26 | | | 3 | | | | | | | 0.151 | | | 6.3 |
| 2 | 1.3 | | 0.23 | 0.25 | 2 | 1 | 3 | | | | | | | 0.165 | 8.4 | 7.7 | 6.4 |
| 3 | 1.2 | | 0.21 | 0.25 | 3 | 1 | 3 | | | | | | 0.022 | 0.164 | 8.3 | 7.7 | 6.1 |
| 4 | 1.2 | | 0.24 | 0.26 | 3 | 1 | 3 | | | | | | | 0.151 | 8.4 | 7.7 | 6.5 |
| 5 | 1.3 | | 0.23 | 0.26 | 3 | 1 | 3 | | | | | | | 0.163 | 8.3 | 7.6 | 6.4 |
| 6 | 1.3 | | 0.23 | 0.26 | | | 3 | | | | | | | 0.135 | | | 6.5 |
| 7 | 1.2 | | 0.23 | 0.26 | | | 3 | | | | | | | 0.136 | | | 6.7 |
| 8 | 1.3 | | 0.25 | 0.26 | 3 | 1 | 3 | | | | | | | 0.143 | 8.4 | 7.7 | 7.1 |
| 9 | 1.2 | | 0.22 | 0.26 | 3 | 1 | 3 | | | | | | 0.121 | 0.121 | 8.4 | 7.7 | 6.7 |
| 10 | 1.2 | | 0.20 | 0.25 | 3 | 1 | 3 | | | | | | | 0.138 | 8.3 | 7.6 | 6.1 |
| 11 | 1.2 | | 0.24 | 0.27 | 2 | 1 | 3 | | | | | | | 0.128 | 8.4 | 7.8 | 6.4 |
| 12 | 1.1 | | 0.23 | 0.29 | 3 | 1 | 3 | | | | | | | 0.139 | 8.2 | 7.6 | 6.3 |
| 13 | 1.6 | | 0.25 | 0.26 | | | 3 | | | | | | | 0.162 | | | 6.3 |
| 14 | 1.6 | | 0.24 | 0.28 | | | 3 | | | | | | | 0.118 | | | 7.1 |
| 15 | 1.3 | | 0.21 | 0.26 | 3 | 1 | 3 | | | | | | | 0.096 | 8.2 | 7.6 | 5.6 |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1(cont'd.)

JULY 1985

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Al (mg/L)(1) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 1.4 | | 0.24 | 0.27 | 3 | 1 | 3 | | | | | | 0.023 | 0.096 | 8.1 | 7.5 | 6.3 |
| 17 | 1.5 | | 0.23 | 0.27 | 3 | 1 | 3 | | | | | | | 0.110 | 8.2 | 7.5 | 5.8 |
| 18 | 1.2 | | 0.21 | 0.23 | 3 | 1 | 3 | | | | | | | 0.100 | 8.1 | 7.6 | 6.6 |
| 19 | 1.1 | | 0.16 | 0.19 | 2 | 1 | 3 | | | | | | | 0.114 | 8.2 | 7.5 | 6.5 |
| 20 | 1.1 | | 0.17 | 0.19 | | | 3 | | | | | | | 0.108 | | | 6.3 |
| 21 | 1.2 | | 0.25 | 0.21 | | | 5/3 | | | | | | | 0.098 | | | 7.5 |
| 22 | 1.3 | | 0.23 | 0.22 | 3 | 1 | 4/3 | | | | | | | 0.155 | 8.4 | 7.4 | 7.9 |
| 23 | 1.1 | | 0.19 | 0.20 | 3 | 1 | 3 | | | | | | | 0.146 | 8.3 | 7.5 | 7.0 |
| 24 | 1.0 | | 0.18 | 0.20 | 3 | 1 | 3 | | | | | | | 0.140 | 8.1 | 7.5 | 6.2 |
| 25 | 0.95 | | 0.16 | 0.20 | 3 | 1 | 3 | | | | | | | 0.113 | 8.1 | 7.4 | 5.9 |
| 26 | 0.91 | | 0.14 | 0.19 | 3 | 1 | 3 | | | | | | 0.075 | 0.135 | 8.1 | 7.4 | 6.4 |
| 27 | 0.94 | | 0.14 | 0.19 | | | 3 | | | | | | | 0.106 | | | 8.1 |
| 28 | 0.84 | | 0.15 | 0.19 | | | 4/3 | | | | | | | 0.116 | | | 10.3 |
| 29 | 0.85 | | 0.16 | 0.21 | 2 | 1 | 3 | | | | | | | 0.163 | 8.3 | 7.5 | 9.7 |
| 30 | 0.68 | | 0.19 | 0.21 | 3 | 1 | 3 | | | | | | 0.109 | 0.117 | 8.3 | 7.5 | 10.7 |
| 31 | 0.79 | | 0.19 | 0.20 | 2 | 1 | 3 | | | | | | | 0.129 | 8.2 | 7.5 | 13.1 |

* Alum – max./min.

– avg.

(1) Raw-Total
Treated-Filtered

## TABLE 2.1 PARTICULATE REMOVAL PROFILE    OCTOBER 1985



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES.(1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 0.55 | | 0.13 | 0.20 | 2 | 1 | 3 | | | | | | | 0.120 | 8.0 | 7.4 | 7.5 |
| 2 | 0.52 | | 0.13 | 0.12 | 2 | 1 | 3 | | | | | | 0.013 | 0.089 | 8.0 | 7.5 | 5.9 |
| 3 | 0.53 | | 0.12 | 0.13 | 2 | 1 | 3 | | | | | | | 0.069 | 8.0 | 7.4 | 5.4 |
| 4 | 0.58 | | 0.12 | 0.16 | 2 | 1 | 3 | | | | | | | 0.101 | 7.9 | 7.5 | 6.4 |
| 5 | 1.7 | | 0.15 | 0.19 | | | 3 | | | | | | | 0.137 | | | 9.9 |
| 6 | 1.3 | | 0.13 | 0.11 | | | 3 | | | | | | | 0.085 | | | 7.0 |
| 7 | 1.3 | | 0.13 | 0.11 | 2 | 1 | 3 | | | | | | | 0.075 | 7.9 | 7.5 | 5.8 |
| 8 | 1.1 | | 0.12 | 0.11 | 2 | 1 | 3 | | | | | | 0.033 | 0.100 | 7.9 | 7.5 | 5.2 |
| 9 | 0.45 | | 0.11 | 0.12 | 2 | 1 | 3 | | | | | | | 0.081 | 7.9 | 7.4 | 5.3 |
| 10 | 0.91 | | 0.17 | 0.13 | 2 | 1 | 3 | | | | | | | 0.077 | 8.0 | 7.4 | 5.6 |
| 11 | 0.70 | | 0.12 | 0.12 | 3 | 1 | 3 | | | | | | | 0.115 | 7.8 | 7.5 | 6.0 |
| 12 | 0.58 | | 0.14 | 0.15 | | | 3 | | | | | | | 0.074 | | | 6.3 |
| 13 | 0.64 | | 0.12 | 0.14 | | | 3 | | | | | | | 0.052 | | | 6.5 |
| 14 | 0.72 | | 0.14 | 0.16 | | | 3 | | | | | | | 0.072 | | | 8.9 |
| 15 | 0.81 | | 0.16 | 0.19 | 2 | 1 | 3 | | | | | | 0.020 | 0.101 | 8.1 | 7.6 | 11.1 |

* Alum - max./min.
- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1(cont'd.)

OCTOBER 1985

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Al/Fe (mg/L) (1) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 0.81 | | 0.16 | 0.16 | 2 | 1 | 3 | | | | | | | 0.175 | 8.1 | 7.7 | 11.5 |
| 17 | 0.79 | | 0.15 | 0.14 | 2 | 1 | 3 | | | | | | | 0.163 | 8.2 | 7.7 | 11.3 |
| 18 | 0.81 | | 0.16 | 0.15 | 2 | 1 | 3 | | | | | | | 0.125 | 8.2 | 7.7 | 11.2 |
| 19 | 0.82 | | 0.16 | 0.16 | | | 3 | | | | | | | 0.168 | | | 11.1 |
| 20 | 0.85 | | 0.17 | 0.17 | | | 3 | | | | | | | 0.109 | | | 11.6 |
| 21 | 0.93 | | 0.17 | 0.18 | 2 | 1 | 3 | | | | | | | 0.175 | 8.2 | 7.5 | 12.1 |
| 22 | 0.83 | | 0.18 | 0.17 | 2 | 1 | 3 | | | | | | | 0.215 | 8.2 | 7.7 | 12.3 |
| 23 | 0.96 | | 0.19 | 0.18 | 2 | 1 | 3 | | | | | | 0.025 | 0.193 | 8.3 | 7.7 | 12.6 |
| 24 | 0.82 | | 0.21 | 0.19 | 2 | 1 | 3 | | | | | | | 0.205 | 8.3 | 7.5 | 12.8 |
| 25 | 0.60 | | 0.24 | 0.19 | 2 | 1 | 3 | | | | | | | 0.236 | 8.2 | 7.4 | 12.8 |
| 26 | 0.69 | | 0.28 | 0.19 | | | 3 | | | | | | | 0.254 | | | 12.1 |
| 27 | 0.50 | | 0.20 | 0.18 | | | 3 | | | | | | | 0.219 | | | 9.2 |
| 28 | 0.44 | | 0.16 | 0.13 | 2 | 1 | 3 | | | | | | 0.035 | 0.084 | 8.0 | 7.5 | 6.1 |
| 29 | 0.50 | | 0.17 | 0.14 | 2 | 1 | 3 | | | | | | | 0.118 | 8.0 | 7.6 | 6.3 |
| 30 | 0.58 | | 0.17 | 0.16 | 2 | 1 | 3 | | | | | | | 0.103 | 7.9 | 7.6 | 6.3 |
| 31 | 0.96 | | 0.16 | 0.21 | 2 | 1 | 3 | | | | | | | 0.139 | 8.1 | 7.5 | 8.2 |

* Alum - max./min.
- avg.

(1) Raw-Total
Treated-Filtered

TABLE 2.1 PARTICULATE REMOVAL PROFILE JANUARY 1984



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Fe (mg/L)(1) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 1.3 | | 0.30 | 0.35 | | | 2 | | | | | | | | | | 2.0 |
| 2 | 1.2 | | 0.33 | 0.31 | | | 2 | | | | | | | | | | 1.8 |
| 3 | 1.2 | | 0.23 | 0.31 | 3 | 1 | 2 | | | | | | | | 8.1 | 7.7 | 2.1 |
| 4 | 1.2 | | 0.22 | 0.28 | 3 | 1 | 2 | | | | | | | | 8.2 | 7.6 | 3.2 |
| 5 | 1.1 | | 0.32 | 0.31 | 3 | 1 | 2 | | | | | | 0.044 | 0.011 | 8.1 | 7.7 | 2.9 |
| 6 | 1.5 | | 0.27 | 0.29 | 3 | 1 | 2 | | | | | | | | 8.1 | 7.7 | 3.1 |
| 7 | 1.1 | | 0.34 | 0.33 | | | | | | | | | | | | | 2.9 |
| 8 | 0.89 | | 0.28 | 0.31 | | | | | | | | | | | | | 3.4 |
| 9 | 1.4 | | 0.28 | 0.29 | 4 | 1 | 2 | | | | | | | | 8.1 | 7.7 | 2.8 |
| 10 | 0.96 | | 0.10 | 0.23 | 3 | 1 | 2 | | | | | | | | 8.1 | 7.6 | 3.0 |
| 11 | 0.99 | | 0.17 | 0.21 | 3 | 1 | 2 | | | | | | 0.035 | 0.018 | 8.1 | 7.6 | 2.7 |
| 12 | 0.98 | | 0.32 | 0.30 | 3 | 1 | 2 | | | | | | | | 8.1 | 7.7 | 2.1 |
| 13 | 1.8 | | 0.29 | 0.30 | 3 | 1 | 2 | | | | | | | | 8.1 | 7.6 | 1.3 |
| 14 | 1.5 | | 0.28 | 0.29 | | | | | | | | | | 0.012 | | | 1.0 |
| 15 | 1.2 | | 0.29 | 0.29 | | | 2 | | | | | | | | | | 0.6 |

* Ferric Chloride - max./min.

- avg.

(1) Raw-Total
Treated-Total

TABLE 2.1(cont'd.)

JANUARY 1984



| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Fe (mg/L) (1) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 1.1 | | 0.29 | 0.29 | 3 | 1 | 2 | | | | | | 0.045 | 0.022 | 8.1 | 7.7 | 0.5 |
| 17 | 0.98 | | 0.26 | 0.29 | 3 | 1 | 2 | | | | | | | | 8.1 | 7.6 | 1.1 |
| 18 | 0.89 | | 0.25 | 0.27 | 3 | 1 | 2 | | | | | | | | 8.1 | 7.6 | 2.0 |
| 19 | 0.91 | | 0.31 | 0.27 | 2 | 1 | | | | | | | | | 8.1 | 7.7 | 2.3 |
| 20 | 1.1 | | 0.33 | 0.31 | 2 | 1 | | | | | | | | | 8.1 | 7.6 | 2.3 |
| 21 | 0.96 | | 0.32 | 0.30 | | | 2 | | | | | | | | | | 2.5 |
| 22 | 1.1 | | 0.26 | 0.28 | | | | | | | | | | | | | 1.7 |
| 23 | 0.95 | | 0.33 | 0.30 | 2 | 1 | | | | | | | | | 8.1 | 7.6 | 2.0 |
| 24 | 0.99 | | 0.31 | 0.30 | 3 | 1 | 2 | | | | | | | | 8.0 | 7.6 | 1.8 |
| 25 | 1.4 | | 0.18 | 0.18 | 3 | 1 | 2 | | | | | | | | 8.0 | 7.4 | 2.3 |
| 26 | 0.90 | | 0.25 | 0.26 | 3 | 1 | | | | | | | 0.014 | 0.010 | 8.0 | 7.6 | 2.5 |
| 27 | 3.5 | | 0.19 | 0.23 | 3 | 1 | 3/2 | | | | | | | 0.013 | 8.0 | 7.5 | 2.3 |
| 28 | 1.6 | | 0.20 | 0.16 | | | 3/2 | | | | | | | 0.011 | | | 2.2 |
| 29 | 2.0 | | 0.23 | 0.25 | | | 3 | | | | | | | | | | 2.5 |
| 30 | | | | | | | | | | | | | | | | | |
| 31 | | | | | | | | | | | | | | | | | |

* Ferric - Chloride - max./min.

- avg.

(1) Raw-Total
Treated-Total

## TABLE 2.1 PARTICULATE REMOVAL PROFILE  APRIL 1984



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. Fe (mg/L) (1) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 1.8 | | 0.13 | 0.10 | | | 2 | | | | | | | 0.024 | | | 1.7 |
| 2 | 1.7 | | 0.11 | 0.10 | 3 | 1 | 2 | | | | | | 0.018 | 0.024 | 8.1 | 7.5 | 1.8 |
| 3 | 1.3 | | 0.10 | 0.10 | 3 | 1 | 2 | | | | | | | | 8.0 | 7.4 | 2.0 |
| 4 | 0.83 | | 0.10 | 0.10 | 2 | 1 | 2 | | | | | | | | 8.0 | 7.4 | 2.1 |
| 5 | 2.1 | | 0.12 | 0.10 | 2 | 1 | 2 | | | | | | | | 8.0 | 7.4 | 2.4 |
| 6 | 2.8 | | 0.13 | 0.11 | 3 | 1 | 3/2 | | | | | | | | 8.0 | 7.4 | 2.4 |
| 7 | 1.8 | | 0.13 | 0.11 | | | 2 | | | | | | | | | | 2.4 |
| 8 | 1.7 | | 0.13 | 0.12 | | | 2 | | | | | | | | | | 2.3 |
| 9 | 1.8 | | 0.14 | 0.13 | 4 | 1 | 2 | | | | | | | | 8.1 | 7.5 | 2.6 |
| 10 | 1.1 | | 0.15 | 0.14 | 3 | 1 | 2 | | | | | | 0.044 | 0.052 | 8.1 | 7.5 | 2.5 |
| 11 | 1.6 | | 0.17 | 0.13 | 3 | 1 | 2 | | | | | | | 0.040 | 8.0 | 7.5 | 2.7 |
| 12 | 1.9 | | 0.18 | 0.14 | 5 | 1 | 2 | | | | | | | 0.040 | 8.1 | 7.3 | 3.1 |
| 13 | 1.6 | | 0.15 | 0.13 | 3 | 1 | 2 | | | | | | | 0.033 | 8.1 | 7.4 | 3.1 |
| 14 | 1.0 | | 0.13 | 0.10 | | | 2 | | | | | | | 0.022 | | | 2.7 |
| 15 | 1.1 | | 0.09 | 0.08 | | | 2 | | | | | | | 0.025 | | | 2.9 |

* Ferric Chloride - max./min.

- avg.

(1) Raw-Total
Treated-Total

TABLE 2.1(cont'd.) APRIL 1984



| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES.[1] Fe (mg/L) | | pH | | TEMP. ($^{o}C$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 1.3 | | 0.10 | 0.11 | 3 | 1 | 2 | | | | | | | 0.028 | 8.1 | 7.3 | 3.0 |
| 17 | 1.3 | | 0.11 | 0.11 | 3 | 1 | 2 | | | | | | | 0.022 | 8.1 | 7.4 | 3.0 |
| 18 | 1.3 | | 0.10 | 0.12 | 3 | 1 | 2 | | | | | | 0.046 | 0.027 | 8.1 | 7.4 | 3.2 |
| 19 | 1.1 | | 0.11 | 0.11 | 3 | 1 | 2 | | | | | | | 0.026 | 8.1 | 7.3 | 3.2 |
| 20 | 0.95 | | 0.09 | 0.12 | | | 2 | | | | | | | 0.030 | | | 3.3 |
| 21 | 0.85 | | 0.09 | 0.11 | | | 2 | | | | | | | 0.029 | | | 3.2 |
| 22 | 0.94 | | 0.09 | 0.11 | | | 2 | | | | | | | 0.036 | | | 3.3 |
| 23 | 1.0 | | 0.11 | 0.12 | | | 2 | | | | | | | 0.025 | | | 3.4 |
| 24 | 0.84 | | 0.11 | 0.14 | 2 | 1 | 2 | | | | | | | 0.030 | 8.1 | 7.5 | 3.2 |
| 25 | 0.98 | | 0.14 | 0.13 | 3 | 1 | 2 | | | | | | | 0.061 | 8.2 | 7.5 | 3.6 |
| 26 | 1.0 | | 0.35 | 0.14 | 2 | 1 | 2 | | | | | | 0.085 | 0.027 | 8.2 | 7.4 | 3.9 |
| 27 | 1.1 | | 0.14 | 0.17 | 3 | 1 | 2 | | | | | | | 0.027 | 8.2 | 7.4 | 3.9 |
| 28 | 1.2 | | 0.15 | 0.16 | | | 2 | | | | | | | 0.024 | | | 4.5 |
| 29 | 0.96 | | 0.13 | 0.13 | | | 2 | | | | | | | 0.027 | | | 4.2 |
| 30 | 1.3 | | 0.19 | 0.15 | 3 | 1 | 2 | | | | | | | 0.039 | 8.2 | 7.6 | 4.7 |
| 31 | | | | | | | | | | | | | | | | | |

*Ferric Chloride - max./min.

- avg.

(1) Raw-Total
· Treated-Total

TABLE 2.1 PARTICULATE REMOVAL PROFILE JULY 1984



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES.(1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 1.1 | | 0.20 | 0.15 | | | 3 | | | | | | | 0.030 | | | 4.8 |
| 2 | 1.0 | | 0.18 | 0.14 | | | 3 | | | | | | | 0.070 | | | 4.7 |
| 3 | 1.1 | | 0.16 | 0.14 | 2 | 1 | 3 | | | | | | | 0.094 | 8.1 | 7.7 | 4.6 |
| 4 | 1.2 | | 0.14 | 0.13 | 2 | 1 | 3 | | | | | | 0.040 | 0.081 | 8.1 | 7.6 | 4.4 |
| 5 | 1.1 | | 0.15 | 0.13 | 2 | 1 | 3 | | | | | | | 0.047 | 8.1 | 7.7 | 4.4 |
| 6 | 1.3 | | 0.10 | 0.11 | 2 | 1 | 3 | | | | | | | 0.060 | 8.1 | 7.5 | 4.6 |
| 7 | 1.2 | | 0.10 | 0.11 | | | 3 | | | | | | | 0.060 | | | 4.6 |
| 8 | 1.2 | | 0.10 | 0.11 | | | 3 | | | | | | | 0.049 | | | 4.6 |
| 9 | 1.2 | | 0.13 | 0.12 | 2 | 1 | 3 | | | | | | | 0.057 | 8.1 | 7.6 | 4.6 |
| 10 | 1.2 | | 0.12 | 0.13 | 2 | 1 | 3 | | | | | | | 0.061 | 8.1 | 7.6 | 4.7 |
| 11 | 1.1 | | 0.12 | 0.13 | 2 | 1 | 3 | | | | | | | 0.057 | 8.1 | 7.4 | 4.7 |
| 12 | 1.2 | | 0.11 | 0.12 | 2 | 1 | 3 | | | | | | | 0.045 | 8.1 | 7.4 | 5.4 |
| 13 | 1.2 | | 0.16 | 0.14 | 2 | 1 | 3 | | | | | | | 0.069 | 8.1 | 7.6 | 5.4 |
| 14 | 1.1 | | 0.16 | 0.15 | | | 3 | | | | | | | 0.148 | | | 5.0 |
| 15 | 1.0 | | 0.13 | 0.13 | | | 3 | | | | | | | 0.131 | | | 4.5 |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Total

TABLE 2.1(cont'd.)

JULY 1984



| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 1.0 | | 0.10 | 0.12 | 3 | 1 | 3 | | | | | | | 0.061 | 8.2 | 7.5 | 4.6 |
| 17 | 1.0 | | 0.10 | 0.12 | 2 | 1 | 3 | | | | | | | 0.095 | 8.3 | 7.6 | 5.0 |
| 18 | 0.98 | | 0.12 | 0.13 | 2 | 1 | 3 | | | | | | | 0.100 | 8.4 | 7.6 | 5.0 |
| 19 | 0.94 | | 0.10 | 0.13 | 2 | 1 | 3 | | | | | | | 0.061 | 8.3 | 7.5 | 5.0 |
| 20 | 0.87 | | 0.08 | 0.11 | 3 | 1 | 3 | | | | | | | 0.077 | 8.3 | 7.5 | 4.6 |
| 21 | 0.84 | | 0.08 | 0.11 | | | 3 | | | | | | | 0.091 | | | 4.6 |
| 22 | 0.99 | | 0.09 | 0.12 | | | 3 | | | | | | | 0.101 | | | 4.6 |
| 23 | 1.1 | | 0.10 | 0.12 | 2 | 1 | 3 | | | | | | | 0.106 | 8.3 | 7.5 | 5.5 |
| 24 | 1.2 | | 0.11 | 0.13 | 2 | 1 | 3 | | | | | | | 0.039 | 8.3 | 7.6 | 6.1 |
| 25 | 1.1 | | 0.12 | 0.13 | 3 | 2 | 3 | | | | | | | 0.181 | 8.4 | 7.6 | 7.9 |
| 26 | 1.2 | | 0.13 | 0.14 | 2 | 1 | 3 | | | | | | | 0.062 | 8.3 | 7.7 | 7.4 |
| 27 | 1.1 | | 0.15 | 0.15 | 2 | 1 | 3 | | | | | | | 0.186 | 8.3 | 7.7 | 7.6 |
| 28 | 1.1 | | 0.17 | 0.16 | | | 3 | | | | | | | 0.104 | | | 9.3 |
| 29 | 1.0 | | 0.18 | 0.18 | | | 3 | | | | | | | 0.118 | | | 12.2 |
| 30 | 1.3 | | 0.16 | 0.17 | 2 | 1 | 3 | | | | | | | 0.180 | 8.3 | 7.6 | 12.9 |
| 31 | 1.3 | | 0.13 | 0.15 | 2 | 1 | 3 | | | | | | | 0.120 | 8.3 | 7.5 | 13.1 |

* Alum - max./min.

\- avg.

(1) Raw-Total
Treated-Total

TABLE 2.1 PARTICULATE REMOVAL PROFILE OCTOBER 1984



WPOS - Toronto Easterly Filtration Plant

| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 1 | 0.65 | | 0.04 | 0.15 | 3 | 1 | 3 | | | | | | | 0.135 | 8.1 | 7.6 | 6.3 |
| 2 | 0.59 | | 0.05 | 0.15 | 3 | 1 | 3 | | | | | | 0.042 | 0.122 | 8.1 | 7.6 | 7.3 |
| 3 | 0.67 | | 0.06 | 0.16 | 2 | 1 | 3 | | | | | | | 0.134 | 8.1 | 7.6 | 7.9 |
| 4 | 0.59 | | 0.06 | 0.16 | 2 | 1 | 3 | | | | | | | 0.051 | 8.0 | 7.6 | 7.0 |
| 5 | 0.54 | | 0.04 | 0.15 | 3 | 1 | 3 | | | | | | | 0.073 | 8.0 | 7.6 | 5.9 |
| 6 | 0.54 | | 0.05 | 0.17 | | | 3 | | | | | | | 0.064 | | | 6.2 |
| 7 | 0.61 | | 0.05 | 0.16 | | | 3 | | | | | | | 0.069 | | | 6.9 |
| 8 | 0.64 | | 0.05 | 0.16 | | | 3 | | | | | | | 0.049 | | | 7.5 |
| 9 | 0.60 | | 0.06 | 0.16 | 3 | 1 | 3 | | | | | | | 0.079 | 8.1 | 7.6 | 8.0 |
| 10 | 0.57 | | 0.06 | 0.16 | 3 | 1 | 3 | | | | | | | 0.051 | 8.2 | 7.6 | 8.4 |
| 11 | 0.84 | | 0.07 | 0.17 | 2 | 1 | 3 | | | | | | | 0.100 | 8.2 | 7.5 | 8.7 |
| 12 | 0.62 | | 0.09 | 0.18 | 2 | 1 | 3 | | | | | | | 0.085 | 8.2 | 7.5 | 8.8 |
| 13 | 0.64 | | 0.11 | 0.20 | | | 3 | | | | | | | 0.122 | | | 4.2 |
| 14 | 0.72 | | 0.12 | 0.21 | | | 3 | | | | | | | 0.138 | | | 9.1 |
| 15 | 0.79 | | 0.19 | 0.24 | 3 | 1 | 3 | | | | | | | 0.080 | 8.3 | 7.7 | 10.5 |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Total

TABLE 2.1(cont'd.)

OCTOBER 1984



| DATE | TURBIDITY (FTU) | | | | COLOUR (TCU) | | COAGULANT* | COAG. AID | (1) | (2) | (3) | (4) | METAL RES. (1) Al (mg/L) | | pH | | TEMP. (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw | Set. | Filter | Treat. | Raw | Treat. | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | Raw | Treat. | Raw | Treat. | |
| 16 | 1.0 | | 0.24 | 0.26 | 2 | 1 | 3 | | | | | | | 0.151 | 8.4 | 7.8 | 11.4 |
| 17 | 0.79 | | 0.23 | 0.27 | 2 | 1 | 3 | | | | | | | 0.154 | 8.4 | 7.6 | 11.8 |
| 18 | 0.70 | | 0.20 | 0.25 | 2 | 1 | 3 | | | | | | | 0.091 | 8.4 | 7.6 | 12.2 |
| 19 | 0.80 | | 0.21 | 0.24 | 2 | 1 | 3 | | | | | | | 0.138 | 8.4 | 7.6 | 12.3 |
| 20 | 1.2 | | 0.17 | 0.23 | | | 3 | | | | | | | 0.116 | | | 12.5 |
| 21 | 2.2 | | 0.19 | 0.24 | | | 3 | | | | | | | 0.150 | | | 12.5 |
| 22 | 2.1 | | 0.21 | 0.25 | 2 | 1 | 3 | | | | | | | 0.132 | 8.3 | 7.6 | 12.5 |
| 23 | 1.2 | | 0.33 | 0.27 | 2 | 1 | 5/3 | | | | | | | 0.045 | 8.3 | 7.6 | 12.3 |
| 24 | 1.4 | | 0.30 | 0.29 | 2 | 1 | 5/3 | | | | | | | 0.082 | 8.2 | 7.5 | 11.5 |
| 25 | 0.67 | | 0.13 | 0.25 | 2 | 1 | 3 | | | | | | | 0.080 | 8.3 | 7.4 | 10.4 |
| 26 | 0.70 | | 0.17 | 0.23 | 2 | 1 | 3 | | | | | | | 0.182 | 8.3 | 7.6 | 11.1 |
| 27 | 0.93 | | 0.23 | 0.26 | | | 5/3 | | | | | | | 0.112 | | | 11.8 |
| 28 | 0.89 | | 0.13 | 0.23 | | | 3 | | | | | | | 0.150 | | | 11.9 |
| 29 | 0.99 | | 0.22 | 0.25 | 2 | 1 | 3 | | | | | | | 0.110 | 8.3 | 7.5 | 12.0 |
| 30 | 0.96 | | 0.28 | 0.28 | 2 | 1 | 3 | | | | | | | 0.148 | 8.4 | 7.6 | 12.0 |
| 31 | 0.77 | | 0.23 | 0.29 | 3 | 1 | 3 | | | | | | | 0.110 | 8.3 | 7.6 | 11.7 |

* Alum - max./min.

- avg.

(1) Raw-Total
Treated-Total

TABLE 3

WATER PLANT OPTIMIZATION STUDY
"DISINFECTION SUMMARY"

TABLE 3.0 • DISINFECTION SUMMARY (mg/L) 1986

WPOS - Toronto Easterly Filtration Plant

| MONTH | CHEMICAL | PRE-CHLORINATION Max. | PRE-CHLORINATION Min. | PRE-CHLORINATION Avg. | POST-CHLORINATION Max. | POST-CHLORINATION Min. | POST-CHLORINATION Avg. | AFTER DECHLORINATION Max. | AFTER DECHLORINATION Min. | AFTER DECHLORINATION Avg. | AFTER AMMONIATION Max. | AFTER AMMONIATION Min. | AFTER AMMONIATION Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JAN | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.80 | 0.9/2.2 (1) | 0.3/1.4 (1) | 0.72 (2) | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.5 | | 0.3 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.26 | 0.13 | 0.19 |
| | $Cl_2$ Resid (Free) | 0.55 | 0.14 | 0.35 | 1.9 | 0.57 | 0.88 | 0.76 | 0.52 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.95 | 0.60 | 0.79 |
| | F Dosage | | | | | | | 1.05 | 0.84 | 0.96 | | | |
| | F Residual | | | | | | | 1.43 | 1.0 | 1.12 | | | |
| FEB | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.81 | 0.7/4.0 | 0.3/1.2 | 0.55 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.3 | | 0.2 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.38 | 0.14 | 0.19 |
| | $Cl_2$ Resid (Free) | 0.72 | 0.12 | 0.45 | 1.7 | 0.65 | 0.86 | 0.80 | 0.50 | 0.62 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.92 | 0.60 | 0.79 |
| | F Dosage | | | | | | | 1.14 | 0.92 | 1.05 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.19 | | | |
| MAR | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.81 | 1.0/3.8 | 0.4/1.1 | 1.2 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.8 | | 0.54 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.28 | 0.10 | 0.19 |
| | $Cl_2$ Resid (Free) | 0.49 | 0.01 | 0.27 | 2.3 | 0.56 | 1.16 | 0.82 | 0.51 | 0.62 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.99 | 0.60 | 0.79 |
| | F Dosage | | | | | | | 1.14 | 0.99 | 1.03 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.18 | | | |

(1) Ordinary chlorination/superchlorination

(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION Max. | PRE-CHLORINATION Min. | PRE-CHLORINATION Avg. | POST-CHLORINATION Max. | POST-CHLORINATION Min. | POST-CHLORINATION Avg. | AFTER DECHLORINATION Max. | AFTER DECHLORINATION Min. | AFTER DECHLORINATION Avg. | AFTER AMMONIATION Max. | AFTER AMMONIATION Min. | AFTER AMMONIATION Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APR | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.79 | (1) 1.0/4.1 | (1) 0.3/1.3 | (2) 1.1 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 2.2 | | 0.56 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.25 | 0 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.53 | 0 | 0.28 | 2.8 | 0.39 | 1.12 | 0.77 | 0.40 | 0.52 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.95 | 0.47 | 0.70 |
| | F Dosage | | | | | | | 1.09 | 1.00 | 1.03 | | | |
| | F Residual | | | | | | | 1.3 | 1.0 | 1.18 | | | |
| MAY | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.80 | 1.1/2.1 | 0.4/1.3 | 0.71 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.2 | | 0.21 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.23 | 0.05 | 0.17 |
| | $Cl_2$ Resid (Free) | 0.37 | 0.05 | 0.28 | 1.9 | 0.50 | 0.76 | 0.66 | 0.41 | 0.52 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.91 | 0.50 | 0.70 |
| | F Dosage | | | | | | | 1.08 | 0.96 | 1.01 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.20 | | | |
| JUN | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.79 | 1.2/2.7 | 0.3/1.2 | 1.0 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.5 | | 0.45 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.24 | 0.06 | 0.17 |
| | $Cl_2$ Resid(Free) | 0.37 | 0 | 0.25 | 2.0 | 0.50 | 0.99 | 0.76 | 0.35 | 0.52 | | | |
| | $Cl_2$ Resid(Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid(Tot.) | | | | | | | | | | 0.90 | 0.43 | 0.71 |
| | F Dosage | | | | | | | 1.15 | 0.78 | 0.99 | | | |
| | F Residual | | | | | | | 1.2 | 1.1 | 1.14 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION Max. | PRE-CHLORINATION Min. | PRE-CHLORINATION Avg. | POST-CHLORINATION Max. | POST-CHLORINATION Min. | POST-CHLORINATION Avg. | AFTER DECHLORINATION Max. | AFTER DECHLORINATION Min. | AFTER DECHLORINATION Avg. | AFTER AMMONIATION Max. | AFTER AMMONIATION Min. | AFTER AMMONIATION Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JUL | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.80 | 1.5/2.8 (1) | 0.4/1.2 (1) | 1.2 (2) | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.5 | | 0.63 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.31 | 0.08 | 0.17 |
| | $Cl_2$ Resid (Free) | 0.56 | 0 | 0.21 | 1.9 | 0.58 | 1.21 | 0.69 | 0.30 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.90 | 0.55 | 0.73 |
| | F Dosage | | | | | | | 1.17 | 0.94 | 1.04 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.17 | | | |
| AUG | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.80 | 1.5/2.7 | 0.4/1.5 | 1.5 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.4 | | 0.80 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.24 | 0 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.42 | 0 | 0.15 | 2.2 | 0.73 | 1.40 | 0.80 | 0.42 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.86 | 0.43 | 0.71 |
| | F Dosage | | | | | | | 1.07 | 0.96 | 1.02 | | | |
| | F Residual | | | | | | | 1.2 | 1.0 | 1.11 | | | |
| SEP | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.80 | 1.3/2.0 | 0.4/1.4 | 1.1 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.3 | | 0.50 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.27 | 0.10 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.50 | 0 | 0.26 | 2.0 | 0.58 | 1.11 | 0.65 | 0.44 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.87 | 0.60 | 0.73 |
| | F Dosage | | | | | | | 1.15 | 0.97 | 1.07 | | | |
| | F Residual | | | | | | | 1.5 | 1.1 | 1.25 | | | |

(1) Ordinary chlorination/superchlorination

(2) Average monthly post-chlorine dosage

TABLE 3.0 (cont'd) (mg/L) 1986 

| MONTH | CHEMICAL | PRE-CHLORINATION | | | POST-CHLORINATION | | | AFTER DECHLORINATION | | | AFTER AMMONIATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| OCT | $Cl_2$ Demand | | | | (1) | (1) | (2) | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.78 | 1.1/2.5 | 0.3/1.4 | 0.92 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.4 | | 0.40 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.27 | 0 | 0.17 |
| | $Cl_2$ Resid (Free) | 0.54 | 0 | 0.31 | 2.0 | 0.59 | 0.99 | 0.75 | 0.42 | 0.57 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.93 | 0.50 | 0.77 |
| | F Dosage | | | | | | | 1.10 | 0.98 | 1.04 | | | |
| | F Residual | | | | | | | 1.3 | 1.2 | 1.26 | | | |
| NOV | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.78 | 1.0/2.3 | 0.5/1.4 | 0.82 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 3.2 | | 0.35 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.30 | 0 | 0.18 |
| | $Cl_2$ Resid (Free) | 1.3 | 0 | 0.33 | 4.1 | 0.70 | 1.08 | 1.3 | 0.52 | 0.62 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 2.8 | 0.66 | 0.82 |
| | F Dosage | | | | | | | 1.05 | 0.96 | 1.10 | | | |
| | F Residual | | | | | | | 1.3 | 0.5 | 1.15 | | | |
| DEC | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.77 | 1.0/8.1 | 0.5/1.4 | 1.4 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.8 | | 0.62 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.30 | 0.05 | 0.18 |
| | $Cl_2$ Resid (Free) | 0.70 | 0 | 0.21 | 2.4 | 0.70 | 1.36 | 0.90 | 0.44 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.98 | 0.57 | 0.81 |
| | F Dosage | | | | | | | 1.04 | 0.90 | 0.99 | | | |
| | F Residual | | | | | | | 1.3 | 1.0 | 1.17 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION | | | POST-CHLORINATION | | | AFTER DECHLORINATION | | | AFTER AMMONIATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| JAN | $Cl_2$ Demand | | | | (1) | (1) | (2) | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.77 | 1.1/3.9 | 0.3/1.2 | 1.0 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 2.0 | | 0.41 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.28 | 0 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.5 | 0.12 | 0.28 | 2.4 | 0.57 | 1.05 | 0.72 | 0.50 | 0.60 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 1.0 | 0.65 | 0.79 |
| | F Dosage | | | | | | | 1.09 | 0.95 | 1.02 | | | |
| | F Residual | | | | | | | 1.3 | 1.2 | 1.21 | | | |
| FEB | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.78 | 0.9/5.1 | 0.3/1.2 | 0.87 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.6 | | 0.26 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.24 | 0 | 0.15 |
| | $Cl_2$ Resid (Free) | 0.52 | 0.01 | 0.30 | 2.7 | 0.61 | 0.91 | 0.82 | 0.53 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.97 | 0.62 | 0.78 |
| | F Dosage | | | | | | | 1.08 | 0.90 | 1.01 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.18 | | | |
| MAR | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.78 | 1.0/5.2 | 0.3/1.1 | 1.3 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.9 | | 0.62 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.23 | 0 | 0.17 |
| | $Cl_2$ Resid (Free) | 0.62 | 0.02 | 0.23 | 2.2 | 0.60 | 1.24 | 0.72 | 0.50 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 1.0 | 0.56 | 0.78 |
| | F Dosage | | | | | | | 1.07 | 0.97 | 1.00 | | | |
| | F Residual | | | | | | | 1.3 | 1.2 | 1.21 | | | |

(1) Ordinary chlorination/superchlorination
(2). Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION Max. | PRE-CHLORINATION Min. | PRE-CHLORINATION Avg. | POST-CHLORINATION Max. | POST-CHLORINATION Min. | POST-CHLORINATION Avg. | AFTER DECHLORINATION Max. | AFTER DECHLORINATION Min. | AFTER DECHLORINATION Avg. | AFTER AMMONIATION Max. | AFTER AMMONIATION Min. | AFTER AMMONIATION Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| APR | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.79 | 1.0/3.2 | 0.2/1.2 | 0.90 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.9 | | 0.33 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.30 | 0 | 0.15 |
| | $Cl_2$ Resid (Free) | 0.46 | 0.05 | 0.27 | 2.1 | 0.55 | 0.93 | 0.69 | 0.40 | 0.53 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.90 | 0.50 | 0.71 |
| | F Dosage | | | | | | | 1.05 | 0.96 | 1.02 | | | |
| | F Residual | | | | | | | 1.3 | 0.8 | 1.21 | | | |
| MAY | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.78 | 0.9/2.7 | 0.2/1.1 | 0.85 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.6 | | 0.30 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.25 | 0 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.38 | 0.06 | 0.25 | 1.9 | 0.47 | 0.87 | 0.90 | 0.30 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.97 | 0.51 | 0.71 |
| | F Dosage | | | | | | | 1.05 | 0.97 | 1.01 | | | |
| | F Residual | | | | | | | 1.2 | 1.1 | 1.18 | | | |
| JUN | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.79 | 1.0/2.5 | 0.2/1.3 | 1.0 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.5 | | 0.48 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.23 | 0 | 0.15 |
| | $Cl_2$ Resid(Free) | 0.45 | 0.07 | 0.24 | 2.0 | 0.44 | 1.04 | 0.63 | 0.35 | 0.51 | | | |
| | $Cl_2$ Resid(Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid(Tot.) | | | | | | | | | | 0.88 | 0.42 | 0.71 |
| | F Dosage | | | | | | | 1.07 | 0.92 | 1.01 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.20 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION | | | POST-CHLORINATION | | | AFTER DECHLORINATION | | | AFTER AMMONIATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| JUL | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.80 | (1) 1.6/3.1 | (1) 0.3/1.5 | (2) 1.0 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.8 | | 0.43 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.29 | 0 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.39 | 0.11 | 0.24 | 2.7 | 0.47 | 0.97 | 0.68 | 0.42 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.97 | 0.52 | 0.73 |
| | F Dosage | | | | | | | 1.10 | 0.96 | 1.03 | | | |
| | F Residual | | | | | | | 1.3 | 1.2 | 1.24 | | | |
| AUG | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.81 | 1.0/3.5 | 0.5/1.5 | 1.9 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.7 | | 0.95 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.25 | 0 | 0.17 |
| | $Cl_2$ Resid (Free) | 0.48 | 0.02 | 0.12 | 2.5 | 0.55 | 1.55 | 0.81 | 0.38 | 0.31 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.92 | 0.58 | 0.74 |
| | F Dosage | | | | | | | 1.13 | 0.94 | 1.03 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.23 | | | |
| SEP | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.78 | 0.8/3.1 | 0.5/1.3 | 1.6 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.4 | | 0.76 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.24 | 0.07 | 0.17 |
| | $Cl_2$ Resid (Free) | 0.38 | 0.03 | 0.14 | 1.9 | 0.45 | 1.32 | 0.62 | 0.40 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.93 | 0.55 | 0.74 |
| | F Dosage | | | | | | | 1.12 | 0.96 | 1.03 | | | |
| | F Residual | | | | | | | 1.4 | 1.2 | 1.27 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION | | | POST-CHLORINATION | | | AFTER DECHLORINATION | | | AFTER AMMONIATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| OCT | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.79 | (1) 0.9/3.4 | (1) 0.2/1.3 | (2) 1.0 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.3 | | 0.43 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.35 | 0.09 | 0.18 |
| | $Cl_2$ Resid (Free) | 0.46 | 0.05 | 0.26 | 1.9 | 0.50 | 1.01 | 0.70 | 0.40 | 0.59 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.98 | 0.60 | 0.79 |
| | F Dosage | | | | | | | 1.16 | 0.97 | 1.04 | | | |
| | F Residual | | | | | | | 1.4 | 1.1 | 1.26 | | | |
| NOV | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.78 | 0.9/4.6 | 0.4/1.0 | 1.1 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.6 | | 0.42 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.26 | 0.12 | 0.18 |
| | $Cl_2$ Resid (Free) | 0.45 | 0.05 | 0.25 | 2.1 | 0.58 | 1.05 | 0.72 | 0.50 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 1.0 | 0.55 | 0.78 |
| | F Dosage | | | | | | | 1.13 | 0.98 | 1.03 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.22 | | | |
| DEC | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.79 | 0.9/6.3 | 0.3/1.0 | 0.85 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 2.7 | | 0.3 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.28 | 0.14 | 0.19 |
| | $Cl_2$ Resid (Free) | 0.49 | 0 | 0.31 | 2.1 | 0.49 | 0.90 | 0.72 | 0.50 | 0.62 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.91 | 0.60 | 0.77 |
| | F Dosage | | | | | | | 1.13 | 0.91 | 1.04 | | | |
| | F Residual | | | | | | | 1.3 | 1.0 | 1.21 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION | | | POST-CHLORINATION | | | AFTER DECHLORINATION | | | AFTER AMMONIATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| JAN | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.82 | [1] 0.8/4.0 | [1] 0.3/1.0 | [2] 0.76 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.1 | | 0.19 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.29 | 0.11 | 0.19 |
| | $Cl_2$ Resid (Free) | 0.81 | 0.14 | 0.30 | 2.0 | 0.54 | 0.85 | 0.75 | 0.50 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 1.1 | 0.59 | 0.75 |
| | F Dosage | | | | | | | 0.87 | 0.70 | 0.83 | | | |
| | F Residual | | | | | | | 1.0 | 0.9 | 0.99 | | | |
| FEB | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.80 | 0.9/5.4 | 0.2/1.0 | 0.82 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 2.3 | | 0.24 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.30 | 0.11 | 0.19 |
| | $Cl_2$ Resid (Free) | 0.99 | 0.07 | 0.28 | 3.1 | 0.54 | 0.90 | 0.77 | 0.50 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 1.1 | 0.52 | 0.77 |
| | F Dosage | | | | | | | 0.94 | 0.75 | 0.83 | | | |
| | F Residual | | | | | | | 1.1 | 0.3 | 0.95 | | | |
| MAR | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.83 | 0.9/3.3 | 0.2/1.0 | 0.70 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.6 | | 0.30 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.25 | 0.07 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.89 | 0.17 | 0.31 | 1.8 | 0.51 | 0.83 | 0.70 | 0.30 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.84 | 0.45 | 0.67 |
| | F Dosage | | | | | | | 0.89 | 0.73 | 0.81 | | | |
| | F Residual | | | | | | | 1.2 | 0.9 | 1.0 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION | | | POST-CHLORINATION | | | AFTER DECHLORINATION | | | AFTER AMMONIATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| APR | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.81 | (1) 1.0/2.8 | (1) 0.2/1.1 | (2) 0.55 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.5 | | 0.15 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.23 | 0.12 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.82 | 0.4 | 0.30 | 2.0 | 0.49 | 0.69 | 0.69 | 0.33 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.98 | 0.48 | 0.66 |
| | F Dosage | | | | | | | 0.93 | 0.75 | 0.81 | | | |
| | F Residual | | | | | | | 1.1 | 0.9 | 0.99 | | | |
| MAY | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.82 | 1.0/3.0 | 0.2/1.0 | 0.95 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.6 | | 0.40 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.28 | 0 | 0.16 |
| | $Cl_2$ Resid (Free) | 1.0 | 0.07 | 0.26 | 1.9 | 0.48 | 0.93 | 0.75 | 0.22 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.99 | 0.32 | 0.67 |
| | F Dosage | | | | | | | 0.86 | 0.71 | 0.78 | | | |
| | F Residual | | | | | | | 1.1 | 0.9 | 0.98 | | | |
| JUN | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.82 | 1.2/2.9 | 0.2/1.0 | 0.72 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.5 | | 0.22 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.22 | 0.05 | 0.15 |
| | $Cl_2$ Resid (Free) | 0.36 | 0.05 | 0.25 | 1.8 | 0.48 | 0.79 | 0.69 | 0.40 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.86 | 0.47 | 0.68 |
| | F Dosage | | | | | | | 0.84 | 0.72 | 0.76 | | | |
| | F Residual | | | | | | | 1.0 | 0.9 | 0.93 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION | | | POST-CHLORINATION | | | AFTER DECHLORINATION | | | AFTER AMMONIATION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| JUL | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.82 | (1) 1.4/2.7 | (1) 0.2/1.1 | (2) 0.90 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.5 | | 0.36 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.27 | 0.07 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.47 | 0.10 | 0.25 | 2.1 | 0.53 | 0.93 | 0.65 | 0.35 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.91 | 0.50 | 0.70 |
| | F Dosage | | | | | | | 1.05 | 0.75 | 0.90 | | | |
| | F Residual | | | | | | | 1.2 | 0.9 | 1.08 | | | |
| AUG | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.79 | 1.0/4.0 | 0.3/1.0 | 1.8 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.7 | | 0.87 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.24 | 0 | 0.15 |
| | $Cl_2$ Resid (Free) | 0.41 | 0 | 0.12 | 2.3 | 0.50 | 1.41 | 0.64 | 0.40 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.90 | 0.41 | 0.70 |
| | F Dosage | | | | | | | 1.13 | 0.90 | 0.97 | | | |
| | F Residual | | | | | | | 1.3 | 0.9 | 1.12 | | | |
| SEP | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0 | 0.83 | 1.1/5.0 | 0.2/1.1 | 1.2 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.6 | | 0.53 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.24 | 0 | 0.14 |
| | $Cl_2$ Resid (Free) | 0.41 | 0.06 | 0.22 | 1.9 | 0.46 | 1.07 | 0.63 | 0.45 | 0.51 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.84 | 0.56 | 0.68 |
| | F Dosage | | | | | | | 1.07 | 0.89 | 0.98 | | | |
| | F Residual | | | | | | | 1.2 | 0.9 | 1.13 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

| MONTH | CHEMICAL | PRE-CHLORINATION Max. | PRE-CHLORINATION Min. | PRE-CHLORINATION Avg. | POST-CHLORINATION Max. | POST-CHLORINATION Min. | POST-CHLORINATION Avg. | AFTER DECHLORINATION Max. | AFTER DECHLORINATION Min. | AFTER DECHLORINATION Avg. | AFTER AMMONIATION Max. | AFTER AMMONIATION Min. | AFTER AMMONIATION Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OCT | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.83 | 1.0/3.3 | 0.2/1.2 | 1.3 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 1.5 | | 0.45 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.27 | 0 | 0.16 |
| | $Cl_2$ Resid (Free) | 0.36 | 0.08 | 0.22 | 1.8 | 0.51 | 1.06 | 0.73 | 0.44 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 1.0 | 0.50 | 0.78 |
| | F Dosage | | | | | | | 1.06 | 0.89 | 0.98 | | | |
| | F Residual | | | | | | | 1.3 | 1.1 | 1.18 | | | |
| NOV | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.83 | 1.1/3.7 | 0.2/1.1 | 1.3 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 2.1 | | 0.58 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.34 | 0 | 0.17 |
| | $Cl_2$ Resid (Free) | 0.50 | 0.03 | 0.26 | 2.7 | 0.59 | 1.23 | 0.73 | 0.50 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.93 | 0.56 | 0.77 |
| | F Dosage | | | | | | | 1.04 | 0.84 | 0.95 | | | |
| | F Residual | | | | | | | 1.2 | 1.0 | 1.15 | | | |
| DEC | $Cl_2$ Demand | | | | | | | | | | | | |
| | $Cl_2$ Dosage | 0.8 | 0.8 | 0.81 | 1.1/3.9 | 0.2/1.0 | 1.1 | | | | | | |
| | $SO_2$ Dosage | | | | | | | 3.0 | | 0.47 | | | |
| | $NH_3$ Dosage | | | | | | | | | | 0.28 | 0 | 0.15 |
| | $Cl_2$ Resid (Free) | 0.59 | 0.05 | 0.29 | 3.3 | 0.54 | 1.14 | 0.73 | 0.45 | 0.61 | | | |
| | $Cl_2$ Resid (Comb) | | | | | | | | | | | | |
| | $Cl_2$ Resid (Tot.) | | | | | | | | | | 0.98 | 0.57 | 0.77 |
| | F Dosage | | | | | | | 1.11 | 0.91 | 1.03 | | | |
| | F Residual | | | | | | | 1.3 | 1.0 | 1.19 | | | |

(1) Ordinary chlorination/superchlorination
(2) Average monthly post-chlorine dosage

TABLE 3.1: DISINFECTION PROFILE (mg/L) JANUARY 1986



WPOS - Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION | | POST-CHLORINATION | | AFTER DECHLORINATION | | AFTER AMMONIATION | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. (1) | Free $Cl_2$ Res. | (2) $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | (3) $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.39 | 0.6/0.5<br>- | 0.79 | 0.2 | 0.63 | 0.20.0.17 | 0.78 | 0.96 | 1.12 |
| 2 | 0.8 | 0.38 | 0.6/0.4<br>- | 0.80 | 0.2 | 0.61 | 0.22/0.18 | 0.77 | 1.00 | 1.13 |
| 3 | 0.8 | 0.31 | 0.7/0.4<br>- | 0.71 | 0.1 | 0.64 | 0.22/0.14 | 0.77 | 1.01 | 1.20 |
| 4 | 0.8 | 0.29 | 0.6/0.5<br>- | 0.68 | 0.3 | 0.61 | 0.25/0.15 | 0.76 | 1.00 | 1.15 |
| 5 | 0.8 | 0.23 | 0.6/0.5<br>1.8/1.5 | 1.13 | 0.8 | 0.60 | 0.20/0.18 | 0.77 | 0.94 | 1.15 |
| 6 | 0.8 | 0.28 | 0.5/0.5<br>1.9/1.5 | 1.15 | 1.1 | 0.62 | 0.25/0.16 | 0.77 | 1.05 | 1.28 |
| 7 | 0.8 | 0.27 | 0.7/0.5<br>1.8/1.5 | 1.38 | 1.2 | 0.62 | 0.23/0.19 | 0.77 | 1.03 | 1.25 |
| 8 | 0.8 | 0.38 | 0.5/0.3<br>- | 0.74 | 0.1 | 0.60 | 0.26/0.13 | 0.75 | 0.96 | 1.18 |
| 9 | 0.8 | 0.37 | 0.5/0.4<br>- | 0.68 | 0.1 | 0.59 | 0.24/0.16 | 0.76 | 0.98 | 1.18 |
| 10 | 0.8 | 0.35 | 0.6/0.4<br>- | 0.69 | 0.2 | 0.62 | 0.23/0.19 | 0.77 | 0.97 | 1.17 |
| 11 | 0.8 | 0.36 | 0.7/0.5<br>- | 0.72 | 0.3 | 0.59 | 0.22/0.16 | 0.78 | 1.00 | 1.17 |
| 12 | 0.8 | 0.40 | 0.7/0.5<br>- | 0.70 | 0.4 | 0.61 | 0.26/0.76 | 0.83 | 1.02 | 1.27 |
| 13 | 0.8 | 0.39 | 0.5/0.4<br>2.2/1.7 | 1.37 | 1.4 | 0.62 | 0.23/0.17 | 0.78 | 0.90 | 1.15 |
| 14 | 0.8 | 0.38 | 0.5/0.4<br>- | 0.73 | 0.2 | 0.61 | 0.22/0.17 | 0.76 | 0.89 | 1.08 |
| 15 | 0.8 | 0.43 | 0.5/0.4<br>- | 0.73 | 0.2 | 0.61 | 0.23/0.18 | 0.77 | 0.93 | 1.13 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 3.1 • (Cont'd) (mg/L) JANUARY 1986



| DATE | PRE-CHLORINATION | | POST-CHLORINATION | | AFTER DECHLORINATION | | AFTER AMMONIATION | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. (1) | Free $Cl_2$ Res. | $Cl_2$ Dos. (2) | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. (3) | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.44 | 0.7/0.5<br>- | 0.69 | 0.2 | 0.62 | 0.22/0.18 | 0.83 | 0.84 | 1.07 |
| 17 | 0.8 | 0.36 | 0.6/0.5<br>- | 0.67 | 0.1 | 0.61 | 0.23/0.18 | 0.85 | 0.92 | 1.08 |
| 18 | 0.8 | 0.36 | 0.5/0.5<br>- | 0.75 | 0.1 | 0.58 | 0.23/0.18 | 0.83 | 0.94 | 1.10 |
| 19 | 0.8 | 0.27 | 0.5/0.5<br>1.7/1.4 | 1.02 | 0.9 | 0.61 | 0.20/0.18 | 0.82 | 0.95 | 1.10 |
| 20 | 0.8 | 0.28 | -<br>1.7/1.5 | 1.57 | 1.3 | 0.62 | 0.24/0.16 | 0.84 | 0.92 | 1.07 |
| 21 | 0.8 | 0.24 | 0.5/0.5<br>1.8/1.4 | 1.40 | 1.2 | 0.59 | 0.20/0.16 | 0.82 | 0.91 | 1.02 |
| 22 | 0.8 | 0.33 | 0.8/0.5<br>- | 0.72 | 0.1 | 0.62 | 0.20/0.17 | 0.79 | 0.98 | 1.12 |
| 23 | 0.8 | 0.40 | 0.4/0.4<br>- | 0.71 | 0.2 | 0.64 | 0.24/0.15 | 0.78 | 1.01 | 1.17 |
| 24 | 0.8 | 0.35 | 0.6/0.4<br>1.7/1.5 | 0.91 | 0.8 | 0.61 | 0.23/0.17 | 0.77 | 1.03 | 1.15 |
| 25 | 0.8 | 0.31 | 0.8/0.4<br>- | 0.77 | 0.2 | 0.61 | 0.21/0.18 | 0.77 | 0.92 | 1.03 |
| 26 | 0.8 | 0.30 | 0.6/0.5<br>- | 0.72 | 0.2 | 0.61 | 0.22/0.18 | 0.81 | 0.98 | 1.10 |
| 27 | 0.8 | 0.36 | 0.7/0.4<br>- | 0.70 | 0.2 | 0.62 | 0.21/0.16 | 0.83 | 0.97 | 1.08 |
| 28 | 0.8 | 0.39 | 0.6/0.4<br>- | 0.78 | 0.4 | 0.64 | 0.23/0.19 | 0.82 | 0.96 | 1.12 |
| 29 | 0.8 | 0.31 | 0.6/0.4<br>2.1/1.5 | 1.14 | 1.4 | 0.64 | 0.23/0.19 | 0.80 | 0.96 | 1.08 |
| 30 | 0.8 | 0.49 | 0.6/0.5<br>- | 1.02 | 1.5 | 0.61 | 0.22/0.18 | 0.83 | 0.96 | 1.15 |
| 31 | 0.8 | 0.41 | 0.9/0.4<br>- | 0.79 | 0.4 | 0.61 | 0.22/0.17 | 0.82 | 0.99 | 1.13 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

| DATE | PRE-CHLORINATION | | POST-CHLORINATION | | AFTER DECHLORINATION | | AFTER AMMONIATION | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos.(1) | Free $Cl_2$ Res. | (2) $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | (3) $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.27 | 0.6/0.5<br>2.3/1.4 | 0.92 | 0.7 | 0.60 | 0.22/0.15 | 0.86 | 1.02 | 1.23 |
| 2 | 0.8 | 0.07 | -<br>3.1/1.6 | 1.68 | 1.6 | 0.50 | 0.20/0 | 0.66 | 1.09 | 1.12 |
| 3 | 0.8 | 0.01 | -<br>3.2/2.8 | 1.98 | 1.8 | 0.52 | 0.23/0 | 0.68 | 1.04 | 0.97 |
| 4 | 0.8 | 0.12 | -<br>3.1/1.6 | 1.92 | 2.2 | 0.52 | 0.25/0.14 | 0.66 | 1.04 | 1.13 |
| 5 | 0.8 | 0.19 | -<br>2.0/1.4 | 1.49 | 1.4 | 0.52 | 0.19/0.15 | 0.71 | 1.04 | 1.22 |
| 6 | 0.8 | 0.24 | -<br>1.6/1.3 | 1.57 | 1.3 | 0.50 | 0.18/0.15 | 0.68 | 1.04 | 1.20 |
| 7 | 0.8 | 0.33 | 0.6/0.4<br>1.4/1.4 | 1.12 | 1.1 | 0.51 | 0.20/0.14 | 0.67 | 1.08 | 1.25 |
| 8 | 0.8 | 0.37 | 0.5/0.4<br>- | 0.73 | 0.4 | 0.51 | 0.20/0.16 | 0.68 | 1.04 | 1.23 |
| 9 | 0.8 | 0.38 | 0.6/0.4<br>- | 0.75 | 0.3 | 0.52 | 0.21/0.10 | 0.71 | 1.03 | 1.20 |
| 10 | 0.8 | 0.35 | 0.8/0.5<br>- | 0.77 | 0.3 | 0.54 | 0.20/0.14 | 0.68 | 1.00 | 1.18 |
| 11 | 0.8 | 0.35 | 0.6/0.5<br>4.1/1.5 | 1.35 | 1.6 | 0.55 | 0.23/0.15 | 0.72 | 1.06 | 1.22 |
| 12 | 0.8 | 0.40 | 0.8/0.4<br>- | 0.81 | 0.8 | 0.51 | 0.19/0 | 0.65 | 1.06 | 1.23 |
| 13 | 0.8 | 0.38 | 0.9/0.3<br>- | 0.67 | 0.3 | 0.51 | 0.21/0.10 | 0.64 | 1.05 | 1.20 |
| 14 | 0.8 | 0.10 | 1.0/0.6<br>3.4/1.9 | 1.79 | 2.0 | 0.53 | 0.24/0.13 | 0.75 | 1.02 | 1.18 |
| 15 | 0.8 | 0.17 | -<br>2.4/1.5 | 1.74 | 1.5 | 0.51 | 0.22/0.10 | 0.71 | 1.05 | 1.15 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min.
Super Post-Chlorination - max./min. (3) Max./min.

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.24 | 0.7/0.5<br>2.2/1.5 | 1.40 | 1.4 | 0.50 | 0.20/0.15 | 0.70 | 1.09 | 1.20 |
| 17 | 0.8 | 0.40 | 0.8/0.4<br>-- | 0.79 | 0.5 | 0.51 | 0.22/0 | 0.70 | 1.00 | 1.17 |
| 18 | 0.8 | 0.35 | 0.6/0.4<br>-- | 0.65 | 0.3 | 0.53 | 0.22/0.14 | 0.73 | 1.06 | 1.22 |
| 19 | 0.8 | 0.32 | 0.5/0.4<br>-- | 0.71 | 0.3 | 0.52 | 0.19/0.14 | 0.70 | 1.01 | 1.20 |
| 20 | 0.8 | 0.32 | 0.6/0.4<br>-- | 0.69 | 0.3 | 0.52 | 0.20/0.05 | 0.71 | 1.02 | 1.20 |
| 21 | 0.8 | 0.28 | 0.6/0.4<br>-- | 0.66 | 0.2 | 0.53 | 0.19/0.14 | 0.75 | 1.02 | 1.20 |
| 22 | 0.8 | 0.27 | 0.7/0.5<br>-- | 0.69 | 0.2 | 0.53 | 0.18/0.13 | 0.75 | 1.05 | 1.20 |
| 23 | 0.8 | 0.35 | 0.5/0.4<br>-- | 0.71 | 0.3 | 0.51 | 0.20/0.15 | 0.69 | 1.03 | 1.13 |
| 24 | 0.8 | 0.38 | 0.6/0.4<br>-- | 0.69 | 0.3 | 0.52 | 0.18/0.14 | 0.71 | 1.02 | 1.20 |
| 25 | 0.8 | 0.36 | 0.7/0.4<br>-- | 0.70 | 0.3 | 0.51 | 0.26/0.15 | 0.69 | 1.04 | 1.27 |
| 26 | 0.8 | 0.26 | 0.7/0.5<br>2.0/1.4 | 1.17 | 1.3 | 0.53 | 0.20/0.14 | 0.73 | 1.01 | 1.20 |
| 27 | 0.8 | 0.23 | 0.6/0.5<br>2.1/1.4 | 1.59 | 1.2 | 0.59 | 0.19/0.15 | 0.71 | 1.07 | 1.30 |
| 28 | 0.8 | 0.28 | --<br>2.0/1.3 | 1.76 | 1.3 | 0.51 | 0.19/0.12 | 0.68 | 1.02 | 1.27 |
| 29 | 0.8 | 0.28 | 0.7/0.5<br>2.0/1.4 | 1.33 | 1.3 | 0.50 | 0.21/0.13 | 0.69 | 1.03 | 1.22 |
| 30 | 0.8 | 0.29 | 0.8/0.6<br>-- | 0.78 | 0.4 | 0.51 | 0.24/0.14 | 0.66 | 1.04 | 1.18 |
| 31 | | | | | | | | | | |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. Super Post-Chlorination - max./min. (3) Max./min.

| DATE | PRE-CHLORINATION | | POST-CHLORINATION | | AFTER DECHLORINATION | | AFTER AMMONIATION | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. (1) | Free $Cl_2$ Res. | (2) $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | (3) $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.27 | 0.8/0.5<br>-- | 0.75 | 0.5 | 0.51 | 0.22/0.11 | 0.72 | 1.07 | 1.10 |
| 2 | 0.8 | 0.31 | 0.8/0.6<br>-- | 0.68 | 0.3 | 0.51 | 0.31/0.10 | 0.71 | 0.95 | 1.10 |
| 3 | 0.8 | 0.36 | 0.7/o.5<br>-- | 0.68 | 0.4 | 0.50 | 0.26/0.14 | 0.73 | 0.98 | 1.12 |
| 4 | 0.8 | 0.33 | 0.7/0.5<br>-- | 0.72 | 0.4 | 0.52 | 0.27/0.12 | 0.74 | 1.03 | 1.15 |
| 5 | 0.8 | 0.35 | 0.7/0.5<br>-- | 0.82 | 0.5 | 0.51 | 0.30/0.12 | 0.72 | 0.99 | 1.15 |
| 6 | 0.8 | 0.33 | 1.2/0.5<br>-- | 0.98 | 0.7 | 0.53 | 0.23/0.15 | 0.71 | 0.97 | 1.18 |
| 7 | 0.8/o.o | 0.27 | 1.4/0.5<br>1.7/1.5 | 1.00 | 0.9 | 0.53 | 0.21/0.15 | 0.74 | 1.05 | 1.20 |
| 8 | 0.8 | 0.28 | 0.7/0.4<br>1.9/1.5 | 1.16 | 1.1 | 0.51 | 0.19/0.14 | 0.70 | 1.03 | 1.22 |
| 9 | 0.8 | 0.27 | 1.5/0.7<br>1.7/1.4 | 1.46 | 1.1 | 0.51 | 0.20/0.17 | 0.71 | 1.05 | 1.20 |
| 10 | 0.8 | 0.36 | 1.2/0.5<br>-- | 1.20 | 0.8 | 0.51 | 0.20/0.13 | 0.72 | 1.00 | 1.18 |
| 11 | 0.8 | 0.31 | 1.3/0.5<br>-- | 0.82 | 0.5 | 0.50 | 0.21/0.15 | 0.70 | 1.05 | 1.22 |
| 12 | 0.8 | 0.26 | 0.8/0.5<br>-- | 0.80 | 0.4 | 0.49 | 0.24/0.17 | 0.75 | 1.08 | 1.25 |
| 13 | 0.8 | 0.21 | 0.8/0.8<br>1.8/1.5 | 1.18 | 0.9 | 0.51 | 0.19/0.17 | 0.73 | 1.17 | 1.22 |
| 14 | 0.8 | 0.23 | 0.7/0.6<br>1.8/1.4 | 1.45 | 1.0 | 0.49 | 0.20/0.14 | 0.71 | 1.07 | 1.18 |
| 15 | 0.8 | 0.23 | 0.7/0.6<br>1.7/1.5 | 0.77 | 0.7 | 0.50 | 0.20/0.14 | 0.70 | 1.02 | 1.20 |

(1) Max./min. avg.
(2) Ordinary Post-Chlorination - max./min.
Super Post-Chlorination - max./min.
(3) Max./min.

TABLE 3.1 (Cont'd) (mg/L) JULY 1986



| DATE | PRE-CHLORINATION[1] | | POST-CHLORINATION[2] | | AFTER DECHLORINATION | | AFTER AMMONIATION[3] | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.21 | --<br>2.0/1.3 | 1.38 | 1.1 | 0.50 | 0.21/0.16 | 0.73 | 1.03 | 1.15 |
| 17 | 0.8 | 0.26 | 1.3/0.5<br>2.0/2.0 | 0.90 | 1.1 | 0.51 | 0.20/0.15 | 0.71 | 1.11 | 1.22 |
| 18 | 0.8 | 0.17 | 0.6/0.6<br>1.9/1.5 | 1.08 | 0.8 | 0.52 | 0.23/0.16 | 0.72 | 1.12 | 1.25 |
| 19 | 0.8 | 0.13 | --<br>1.9/1.5 | 1.50 | 1.1 | 0.52 | 0.49/0.15 | 0.72 | 1.11 | 1.23 |
| 20 | 0.8 | 0.15 | --<br>2.0/1.7 | 1.46 | 1.1 | 0.51 | 0.22/0.15 | 0.75 | 1.10 | 1.23 |
| 21 | 0.8/0.0 | 0.13 | --<br>2.8/1.7 | 1.62 | 1.2 | 0.52 | 0.20/0.13 | 0.75 | 1.09 | 1.18 |
| 22 | 0.8 | 0.19 | --<br>1.8/1.2 | 1.53 | 1.2 | 0.52 | 0.19/0.15 | 0.72 | 1.08 | 1.18 |
| 23 | 0.8 | 0.14 | --<br>1.8/1.5 | 1.51 | 1.1 | 0.50 | 0.20/0.13 | 0.71 | 1.09 | 1.20 |
| 24 | 0.8 | 0.17 | --<br>2.2/1.5 | 1.79 | 1.5 | 0.52 | 0.20/0.08 | 0.71 | 1.03 | 1.20 |
| 25 | 0.8 | 0.16 | --<br>1.9/1.5 | 1.53 | 1.1 | 0.52 | 0.21/0.16 | 0.72 | 0.98 | 1.17 |
| 26 | 0.8 | 0.14 | --<br>1.8/1.5 | 1.46 | 1.1 | 0.52 | 0.19/0.17 | 0.73 | 0.94 | 1.10 |
| 27 | 0.8 | 0.12 | --<br>2.1/1.6 | 1.49 | 1.0 | 0.53 | 0.22/0.15 | 0.79 | 0.96 | 1.07 |
| 28 | 0.8 | 0.09 | --<br>1.9/1.5 | 1.39 | 0.9 | 0.56 | 0.22/0.17 | 0.81 | 0.95 | 1.05 |
| 29 | 0.8 | 0.07 | --<br>1.9/1.5 | 1.28 | 1.0 | 0.51 | 0.20/0.14 | 0.74 | 0.98 | 1.08 |
| 30 | 0.8 | 0.07 | --<br>1.9/1.8 | 1.49 | 1.1 | 0.53 | 0.22/0.14 | 0.71 | 0.96 | 1.07 |
| 31 | 0.8 | 0.07 | --<br>2.0/1.6 | 1.57 | 1.2 | 0.51 | 0.21/0.12 | 0.69 | 0.97 | 1.05 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min.
Super Post-Chlorination - max./min. (3) Max./min.

TABLE 3.1 • DISINFECTION PROFILE (mg/L) OCTOBER 1986



WPOS - Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.14 | --<br>1.9/1.6 | 1.54 | 1.1 | 0.51 | 0.16/0.15 | 0.74 | 1.07 | 1.22 |
| 2 | 0.8 | 0.15 | --<br>1.9/1.8 | 1.61 | 1.1 | 0.50 | 0.18/0.16 | 0.76 | 1.04 | 1.20 |
| 3 | 0.8 | 0.11 | --<br>1.9/1.7 | 1.51 | 1.2 | 0.50 | 0.21/0.13 | 0.69 | 1.03 | 1.22 |
| 4 | 0.8 | 0.11 | --<br>1.8/1.5 | 1.38 | 0.9 | 0.52 | 0.18/0.16 | 0.74 | 1.03 | 1.22 |
| 5 | 0.8 | 0.08 | --<br>1.8/1.6 | 1.44 | 0.9 | 0.52 | 0.20/0.15 | 0.75 | 1.05 | 1.18 |
| 6 | 0.8 | 0.19 | 0.7/o.5<br>1.8/1.4 | 1.58 | 1.4 | 0.55 | 0.19/0.16 | 0.76 | 1.04 | 1.27 |
| 7 | 0.8 | 0.17 | 0.7/0.5<br>1.7/1.5 | 1.12 | 0.9 | 0.51 | 0.20/0 | 1.75 | 1.04 | 1.30 |
| 8 | 0.8/1.0 | 0.30 | 1.1/0.6<br>2.5/1.6 | 1.34 | 1.3 | 0.54 | 0.23/0.16 | 0.78 | 1.05 | 1.32 |
| 9 | 0.8 | 0.34 | 0.8/0.6<br>-- | 0.88 | 0.4 | 0.54 | 0.23/0.15 | 0.71 | 1.04 | 1.25 |
| 10 | 0.8 | 0.36 | 0.7/0.6<br>-- | 0.81 | 0.4 | 0.50 | 0.21/0.15 | 0.69 | 1.05 | 1.28 |
| 11 | 0.8 | 0.37 | 0.6/0.5<br>-- | 0.77 | 0.3 | 0.50 | 0.20/0.15 | 0.70 | 1.03 | 1.23 |
| 12 | 0.8 | 0.39 | 0.6/0.5<br>-- | 0.70 | 0.3 | 0.54 | 0.19/0.14 | 0.72 | 1.06 | 1.32 |
| 13 | 0.8 | 0.33 | 0.6/0.5<br>-- | 0.73 | 0.4 | 0.50 | 0.20/0.12 | 0.71 | 1.03 | 1.23 |
| 14 | 0.8 | 0.34 | 0.8/0.5<br>-- | 0.72 | 0.4 | 0.50 | 0.20/0.14 | 0.75 | 1.05 | 1.27 |
| 15 | 0.8 | 0.35 | 1.0/0.6<br>-- | 0.75 | 0.4 | 0.54 | 0.21/0.12 | 0.77 | 1.05 | 1.20 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min.
Super Post-Chlorination - max./min. (3) Max./min.

TABLE 3.1 (Cont'd) (mg/L) OCTOBER 1986 

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.46 | 0.6/0.5<br>1.9/1.8 | 0.91 | 1.1 | 0.62 | 0.22/0.17 | 0.78 | 1.03 | 1.28 |
| 17 | 0.8 | 0.40 | 0.6/0.6<br>-- | 0.85 | 0.4 | 0.61 | 0.26/0.14 | 0.80 | 1.06 | 1.30 |
| 18 | 0.8 | 0.43 | 0.7/0.6<br>-- | 0.88 | 0.4 | 0.63 | 0.25/0.11 | 0.82 | 1.10 | 1.27 |
| 19 | 0.8 | 0.31 | 0.7/0.3<br>-- | 0.82 | 0.3 | 0.61 | 0.22/0.16 | 0.81 | 1.04 | 1.32 |
| 20 | 0.8/0.0 | 0.31 | 0.8/0.5<br>1.5/1.5 | 0.92 | 0.6 | 0.61 | 0.20/0.16 | 0.87 | 0.98 | 1.27 |
| 21 | 0.8 | 0.44 | 0.5/0.5<br>-- | 0.86 | 0.3 | 0.60 | 0.24/0.17 | 0.78 | 1.02 | 1.23 |
| 22 | 0.8 | 0.43 | 0.5/0.5<br>-- | 0.80 | 0.2 | 0.60 | 0.22/0.18 | 0.81 | 1.07 | 1.32 |
| 23 | 0.8 | 0.44 | 0.6/0.5<br>-- | 0.83 | 0.2 | 0.61 | 0.23/0.17 | 0.82 | 1.06 | 1.23 |
| 24 | 0.8 | 0.45 | 0.6/0.5<br>-- | 0.85 | 0.3 | 0.61 | 0.21/0.15 | 0.78 | 1.05 | 1.23 |
| 25 | 0.8 | 0.40 | 0.6/0.5<br>-- | 0.86 | 0.2 | 0.61 | 0.23/0.17 | 0.74 | 1.05 | 1.28 |
| 26 | 0.8 | 1.26 | 0.8/0.6<br>-- | 0.77 | 0.3 | 0.64 | 0.25/0.18 | 0.81 | 1.01 | 1.32 |
| 27 | 0.8/0.0 | 0.30 | 0.8/0.6<br>1.8/1.4 | 0.91 | 0.7 | 0.62 | 0.22/0.17 | 0.79 | 1.04 | 1.32 |
| 28 | 0.8/0.0 | 0.29 | 0.7/0.5<br>1.7/1.5 | 0.83 | 0.5 | 0.62 | 0.22/0.17 | 0.81 | 1.06 | 1.30 |
| 29 | 0.8 | 0.31 | 0.8/0.5<br>-- | 0.83 | 0.3 | 0.61 | 0.23/0.16 | 0.81 | 1.00 | 1.28 |
| 30 | 0.8 | 0.35 | 0.8/0.6<br>-- | 0.79 | 0.3 | 0.58 | 0.27/0.17 | 0.81 | 1.01 | 1.22 |
| 31 | 0.8 | 0.23 | 0.9/0.6<br>1.6/1.5 | 0.97 | 0.8 | 0.59 | 0.23/0.16 | 0.77 | 1.02 | 1.23 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min.
Super Post-Chlorination - max./min. (3) Max./min.

TABLE 3.1 : DISINFECTION PROFILE (mg/L) JANUARY 1985

WPOS - Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.27 | 0.8/0.4<br>2.8/2.7 | 0.77 | 0.3 | 0.59 | 0.19/0.14 | 0.76 | 1.09 | 1.25 |
| 2 | 0.8 | 0.17 | 0.7/0.3<br>3.3/1.4 | 1.63 | 1.4 | 0.62 | 0.20/0.18 | 0.80 | 1.03 | 1.25 |
| 3 | 0.8 | 0.24 | 1.0/0.3<br>2.0/1.5 | 1.48 | 1.4 | 0.59 | 0.20/0.17 | 0.79 | 1.05 | 1.22 |
| 4 | 0.8 | 0.27 | 0.9/0.4<br>3.1/1.7 | 1.28 | 1.5 | 0.59 | 0.19/0.15 | 0.76 | 1.04 | 1.20 |
| 5 | 0.8 | 0.29 | 0.7/0.4<br>- | 0.88 | 0.5 | 0.61 | 0.19/0.15 | 0.79 | 1.02 | 1.18 |
| 6 | 0.8 | 0.32 | 1.1/0.3<br>- | 0.88 | 0.3 | 0.59 | 0.19/0.15 | 0.79 | 1.03 | 1.22 |
| 7 | 0.8 | 0.26 | 0.7/0.4<br>- | 0.81 | 0.5 | 0.61 | 0.20/0.15 | 0.82 | 1.05 | 1.20 |
| 8 | 0.8 | 0.25 | 0.8/0.3<br>2.3/1.2 | 0.97 | 1.1 | 0.60 | 0.19/0.16 | 0.75 | 1.07 | 1.23 |
| 9 | 0.8 | 0.33 | 0.6/0.3<br>- | 0.98 | 1.0 | 0.59 | 0.20/0.16 | 0.75 | 1.07 | 1.27 |
| 10 | 0.8 | 0.38 | 0.6/0.5<br>- | 0.68 | | 0.60 | 0.28/0 | 0.75 | 1.05 | 1.23 |
| 11 | 0.8 | 0.32 | 0.6/0.3<br>- | 0.71 | | 0.64 | 0.20/0.17 | 0.84 | 1.01 | 1.17 |
| 12 | 0.8 | 0.33 | 0.7/0.5<br>- | 0.66 | | 0.60 | 0.20/0.15 | 0.81 | 1.04 | 1.15 |
| 13 | 0.8 | 0.32 | 0.7/0.4<br>- | 0.71 | 0.3 | 0.62 | 0.18/0.16 | 0.79 | 1.03 | 1.18 |
| 14 | 0.8 | 0.31 | 0.7/0.2<br>- | 0.72 | 0.3 | 0.61 | 0.18/0 | 0.78 | 1.00 | 1.13 |
| 15 | 0.8 | 0.34 | 0.7/0.4<br>- | 0.75 | 0.1 | 0.60 | 0.19/0.15 | 0.80 | 0.98 | 1.20 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min.
Super Post-Chlorination - max./min. (3) Max./min.

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.30 | 0.7/0.7<br>- | 0.66 | | 0.59 | 0.22/0.15 | 0.76 | 1.00 | 1.22 |
| 17 | 0.8 | 0.19 | -<br>3.9/1.5 | 1.26 | 1.3 | 0.62 | 0.22/0.14 | 0.80 | 1.03 | 1.25 |
| 18 | 0.8 | 0.18 | -<br>2.6/1.3 | 1.75 | 1.6 | 0.61 | 0.19/0.13 | 0.80 | 0.95 | 1.25 |
| 19 | 0.8 | 0.16 | -<br>2.6/1.6 | 1.79 | 1.9 | 0.61 | 0.18/0.15 | 0.78 | 1.02 | 1.28 |
| 20 | 0.8 | 0.14 | -<br>2.2/1.3 | 1.67 | 1.5 | 0.59 | 0.19/0.15 | 0.78 | 0.99 | 1.25 |
| 21 | 0.8 | 0.20 | -<br>2.3/1.5 | 1.54 | 1.3 | 0.60 | 0.22/0.15 | 0.79 | 0.99 | 1.22 |
| 22 | 0.8 | 0.30 | 0.8/0.3<br>1.6/1.6 | 0.82 | 1.1 | 0.60 | 0.20/0.17 | 0.79 | 0.98 | 1.20 |
| 23 | 0.8 | 0.34 | 1.0/0.3<br>- | 0.77 | 0.4 | 0.62 | 0.20/0.17 | 0.82 | 0.99 | 1.17 |
| 24 | 0.8 | 0.30 | 0.6/0.3<br>- | 0.68 | | 0.59 | 0.22/0.16 | 0.81 | 1.02 | 1.20 |
| 25 | 0.8 | 0.40 | 0.7/0.5<br>- | 0.74 | 0.4 | 0.61 | 0.17/0.15 | 0.82 | 0.98 | 1.22 |
| 26 | 0.8 | 0.36 | 0.7/0.4<br>- | 0.69 | 0.4 | 0.60 | 0.20/0.17 | 0.78 | 1.02 | 1.17 |
| 27 | 0.8 | 0.30 | 0.9/0.6<br>3.6/1.7 | 1.27 | 2.0 | 0.62 | 0.18/0.15 | 0.73 | 1.03 | 1.15 |
| 28 | 0.8 | 0.33 | 0.7/0.3<br>2.1/1.6 | 1.58 | 1.4 | 0.60 | 0.19/0.15 | 0.79 | 1.01 | 1.20 |
| 29 | 0.8 | 0.29 | 0.8/0.3<br>2.6/1.8 | 1.03 | 1.5 | 0.62 | 0.18/0.15 | 0.80 | 1.03 | 1.18 |
| 30 | 0.8 | 0.24 | -<br>1.9/1.5 | 1.55 | 1.3 | 0.60 | 0.18/0.15 | 0.79 | 1.04 | 1.20 |
| 31 | 0.8 | 0.30 | 0.7/0.3<br>- | 0.97 | 1.0 | 0.60 | 0.19/0.15 | 0.89 | 1.00 | 1.20 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. Super Post-Chlorination - max./min. (3) Max/min.

TABLE 3.1 : DISINFECTION PROFILE (mg/L) APRIL 1985

WPOS - Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.37 | 0.8/0.4<br>- | 0.88 | 0.6 | 0.60 | 0.20/0.15 | 0.75 | 1.03 | 1.22 |
| 2 | 0.8 | 0.31 | 0.8/0.2<br>- | 0.82 | 0.4 | 0.60 | 0.22/0.16 | 0.78 | 0.99 | 1.23 |
| 3 | 0.8 | 0.32 | 0.7/0.3<br>- | 0.74 | | 0.60 | 0.20/0.18 | 0.77 | 1.01 | 1.22 |
| 4 | 0.8 | 0.34 | 0.7/0.3<br>- | 0.73 | | 0.60 | 0.20/0.18 | 0.77 | 1.01 | 1.27 |
| 5 | 0.8 | 0.35 | 0.7/0.3<br>- | 0.71 | 0.8 | 0.59 | 0.20/0.17 | 0.76 | 1.00 | 1.27 |
| 6 | 0.8 | 0.34 | 0.7/0.5<br>- | 0.79 | 0.5 | 0.61 | 0.22/0.16 | 0.78 | 1.03 | 1.25 |
| 7 | 0.8 | 0.27 | 0.7/0.3<br>2.4/1.5 | 0.86 | 0.9 | 0.52 | 0.19/0.17 | 0.67 | 1.01 | 1.25 |
| 8 | 0.8 | 0.07 | -<br>2.3/1.8 | 1.53 | 1.3 | 0.52 | 0.19/0.17 | 0.67 | 1.03 | 1.22 |
| 9 | 0.8 | 0.06 | -<br>2.2/1.8 | 1.59 | 1.3 | 0.56 | 0.22/0 | 0.71 | 1.04 | 1.23 |
| 10 | 0.8 | 0.12 | -<br>2.2/1.3 | 1.53 | 1.5 | 0.59 | | 0.72 | 0.96 | 1.10 |
| 11 | 0.8 | 0.43 | 0.6/0.3<br>1.3/1.3 | 1.09 | 1.3 | 0.59 | | 0.70 | 1.04 | 1.32 |
| 12 | 0.8 | 0.22 | 0.9/0.2<br>3.0/2.5 | 0.81 | 1.1 | 0.52 | 0.22/0 | 0.69 | 0.99 | 0.92 |
| 13 | 0.8 | 0.12 | 0.7/0.5<br>3.2/1.5 | 1.76 | 1.9 | 0.52 | 0.18/0.14 | 0.70 | 0.98 | 1.15 |
| 14 | 0.8 | 0.15 | 0.8/0.5<br>3.0/1.4 | 1.34 | 1.5 | 0.49 | 0.20/0.13 | 0.72 | 1.01 | 1.12 |
| 15 | 0.8 | 0.22 | 0.5/0.3<br>2.2/1.2 | 1.60 | 1.5 | 0.52 | 0.20/0.15 | 0.72 | 1.02 | 1.25 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min.
Super Post Chlorination - max./min. (3) Max/min.

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.30 | 0.6/0.3<br>3.2/1.9 | 1.08 | 1.4 | 0.52 | 0.18/0.15 | 0.69 | 1.01 | 1.22 |
| 17 | 0.8 | 0.33 | 0.9/0.3<br>- | 0.79 | 0.6 | 0.50 | 0.16/0.14 | 0.73 | 0.98 | 1.18 |
| 18 | 0.8 | 0.33 | 1.0/0.3<br>- | 0.75 | 0.5 | 0.51 | 0.30/0.14 | 0.69 | 0.97 | 1.22 |
| 19 | 0.8 | 0.28 | 0.8/0.2<br>- | 0.61 | 0.2 | 0.51 | 0.2/0.17 | 0.69 | 1.05 | 1.27 |
| 20 | 0.8 | 0.30 | 0.9/0.4<br>- | 0.70 | 0.3 | 0.53 | 0.19/0.13 | 0.69 | 1.01 | 1.25 |
| 21 | 0.8 | 0.31 | 0.8/0.4<br>- | 0.60 | 0.3 | 0.49 | 0.20/0.17 | 0.68 | 1.05 | 1.25 |
| 22 | 0.8 | 0.30 | 0.9/0.3<br>- | 0.66 | 0.3 | 0.49 | 0.21/0.14 | 0.65 | 1.05 | 1.28 |
| 23 | 0.8 | 0.30 | 1.0/0.2<br>- | 0.72 | 0.4 | 0.49 | 0.21/0.15 | 0.71 | 0.98 | 1.18 |
| 24 | 0.8 | 0.28 | 0.8/0.4<br>- | 0.73 | 0.5 | 0.51 | 0.20/0.14 | 0.70 | 1.01 | 1.20 |
| 25 | 0.8 | 0.27 | 0.9/0.5<br>- | 0.74 | 0.5 | 0.51 | 0.18/0.11 | 0.73 | 1.02 | 1.23 |
| 26 | 0.8 | 0.27 | 0.8/0.6<br>- | 0.77 | 0.3 | 0.51 | 0.20/0.12 | 0.74 | 1.01 | 1.23 |
| 27 | 0.8 | 0.26 | 0.9/0.5<br>- | 0.75 | 0.6 | 0.48 | 0.18/0.14 | 0.67 | 1.05 | 1.23 |
| 28 | 0.8 | 0.24 | 0.8/0.4<br>- | 0.72 | 0.4 | 0.51 | 0.20/0.15 | 0.72 | 1.01 | 1.27 |
| 29 | 0.8 | 0.24 | 1.0/0.5<br>- | 0.83 | 0.5 | 0.49 | 0.20/0.16 | 0.70 | 1.00 | 1.23 |
| 30 | 0.8 | 0.26 | 0.9/0.3<br>- | 0.67 | 0.3 | 0.50 | 0.19/0.10 | 0.69 | 1.05 | 1.17 |
| 31 | | | | | | | | | | |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post Chlorination - max./min.

TABLE 3.1 : DISINFECTION PROFILE (mg/L) JULY 1985 

WPOS - Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.27 | 0.6/0.4<br>1.6/1.6 | 0.88 | 1.4 | 0.49 | 0.19/0 | 0.73 | 1.00 | 1.22 |
| 2 | 0.8 | 0.24 | 0.6/0.5<br>- | 0.60 | 0.3 | 0.51 | 0.18/0 | 0.74 | 0.97 | 1.20 |
| 3 | 0.8 | 0.24 | 0.7.0.5<br>- | 0.55 | 0.2 | 0.50 | 0.22/0.15 | 0.72 | 1.04 | 1.27 |
| 4 | 0.8 | 0.25 | 0.9/0.5<br>- | 0.59 | 0.2 | 0.53 | 0.20/0.15 | 0.70 | 1.02 | 1.23 |
| 5 | 0.8 | 0.29 | 0.9/0.6<br>- | 0.60 | 0.2 | 0.49 | 0.18/0.15 | 0.74 | 1.01 | 1.22 |
| 6 | 0.8 | 0.29 | 0.7/0.5<br>- | 0.68 | 0.3 | 0.51 | 0.28/0.14 | 0.68 | 1.01 | 1.22 |
| 7 | 0.8 | 0.26 | 0.9/0.4<br>- | 0.59 | | 0.50 | 0.21/0.16 | 0.71 | 1.10 | 1.30 |
| 8 | 0.8 | 0.26 | 1.0/0.6<br>- | 0.66 | 0.3 | 0.51 | 0.21/0.08 | 0.73 | 1.02 | 1.23 |
| 9 | 0.8 | 0.23 | 0.9/0.3<br>- | 0.65 | 0.3 | 0.50 | 0.20/0.16 | 0.73 | 1.07 | 1.32 |
| 10 | 0.8 | 0.26 | 0.8/0.5<br>- | 0.60 | 0.2 | 0.50 | 0.26/0.16 | 0.68 | 1.05 | 1.27 |
| 11 | 0.8 | 0.26 | 0.8/0.5<br>- | 0.66 | 0.3 | 0.53 | 0.20/0.14 | 0.70 | 1.01 | 1.25 |
| 12 | 0.8 | 0.24 | 0.8/0.5<br>- | 0.54 | | 0.47 | 0.20/0.06 | 0.70 | 1.05 | 1.25 |
| 13 | 0.8 | 0.24 | 0.8/0.6<br>- | 0.59 | | 0.51 | 0.17/0.13 | 0.76 | 0.97 | 1.20 |
| 14 | 0.8 | 0.23 | 0.8/0.6<br>- | 0.61 | | 0.52 | 0.17/0.15 | 0.74 | 1.01 | 1.18 |
| 15 | 0.8 | 0.24 | 0.9/0.6 | 0.69 | 0.4 | 0.53 | 0.29/0.07 | 0.71 | 1.04 | 1.28 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 3.1 · (Cont'd) (mg/L) JULY 1985 

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.27 | 0.8/0.5<br>- | 0.60 | 0.2 | 0.50 | 0.20/0.16 | 0.73 | 1.03 | 1.27 |
| 17 | 0.8 | 0.22 | 1.0/0.6<br>- | 0.56 | | 0.50 | 0.19/0.16 | 0.78 | 1.08 | 1.23 |
| 18 | 0.8 | 0.24 | 1.3/0.6<br>- | 0.85 | 0.6 | 0.52 | 0.20/0.13 | 0.74 | 1.05 | 1.28 |
| 19 | 0.8 | 0.22 | 1.4/1.1<br>2.2/1.7 | 1.25 | 1.1 | 0.52 | 0.19/0.16 | 0.75 | 1.02 | 1.27 |
| 20 | 0.8 | 0.21 | -<br>2.3/1.9 | 1.86 | 1.5 | 0.53 | 0.20/0.16 | 0.73 | 1.02 | 1.25 |
| 21 | 0.8 | 0.18 | -<br>2.3/1.8 | 1.87 | 1.3 | 0.48 | 0.18/0.14 | 0.73 | 1.04 | 1.27 |
| 22 | 0.8 | 0.22 | 1.3/1.2<br>2.0/1.8 | 1.62 | 1.3 | 0.49 | 0.20/0.14 | 0.74 | 1.03 | 1.30 |
| 23 | 0.8 | 0.23 | 1.4/1.2<br>- | 1.14 | 0.7 | 0.48 | 0.20/0.15 | 0.73 | 1.01 | 1.27 |
| 24 | 0.8 | 0.24 | 1.4/1.1<br>- | 1.17 | 0.7 | 0.51 | 0.20/0.16 | 0.73 | 1.03 | 1.25 |
| 25 | 0.8/0.0 | 0.23 | 1.5/1.2<br>3.1/2.2 | 1.72 | 1.8 | 0.53 | 0.19/0.12 | 0.74 | 0.98 | 1.20 |
| 26 | 0.8 | 0.22 | 1.0/1.0<br>2.6/1.5 | 1.80 | 1.4 | 0.55 | 0.19/0.12 | 0.75 | 1.05 | 1.25 |
| 27 | 0.8 | 0.22 | 1.6/1.1<br>2.3/1.7 | 1.75 | 1.4 | 0.50 | 0.18/0.15 | 0.74 | 1.08 | 1.23 |
| 28 | 0.8 | 0.27 | 1.4/0.9<br>- | 1.10 | 0.8 | 0.51 | 0.20/0.16 | 0.72 | 1.10 | 1.25 |
| 29 | 0.8 | 0.25 | 1.6/1.1<br>- | 1.3 | 0.8 | 0.53 | 0.19/0 | 0.75 | 0.96 | 1.13 |
| 30 | 0.8 | 0.25 | 1.5/1.0<br>- | 1.08 | 0.7 | 0.50 | 0.19/0.15 | 0.72 | 0.99 | 1.30 |
| 31 | 0.8 | 0.24 | 1.4/1.0<br>- | 1.07 | 0.6 | 0.51 | 0.19/0.15 | 0.72 | 1.06 | 1.28 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 3.1 : DISINFECTION PROFILE (mg/L) OCTOBER 1985 

WPOS - Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.28 | 0.9/0.5<br>1.8/1.5 | 1.15 | 1.2 | 0.52 | 0.19/0.09 | 0.70 | 1.01 | 1.23 |
| 2 | 0.8 | 0.35 | 0.6/0.2<br>- | 0.79 | 0.4 | 0.50 | 0.20/0.15 | 0.71 | 1.01 | 1.22 |
| 3 | 0.8 | 0.37 | 0.9/0.4<br>- | 0.83 | 0.4 | 0.51 | 0.20/0.14 | 0.71 | 1.09 | 1.28 |
| 4 | 0.8 | 0.43 | 0.8/0.3<br>- | 0.67 | 0.5 | 0.53 | 0.20/0.14 | 0.72 | 1.12 | 1.40 |
| 5 | 0.8 | 0.26 | 0.7/0.5<br>- | 0.62 | 0.2 | 0.58 | 0.22/0.15 | 0.80 | 1.07 | 1.35 |
| 6 | 0.8 | 0.32 | 0.8/0.6<br>- | 0.75 | 0.6 | 0.63 | 0.24/0.19 | 0.79 | 1.16 | 1.43 |
| 7 | 0.8 | 0.37 | 0.9/0.5<br>- | 0.77 | 0.3 | 0.60 | 0.24/0.18 | 0.74 | 1.08 | 1.35 |
| 8 | 0.8 | 0.29 | 0.6/0.5<br>- | 0.83 | 0.3 | 0.58 | 0.21/0.18 | 0.70 | 1.01 | 1.30 |
| 9 | 0.8 | 0.33 | 0.6/0.5<br>1.8/1.4 | 0.73 | 0.6 | 0.61 | 0.22/0.15 | 0.81 | 1.05 | 1.30 |
| 10 | 0.8 | 0.19 | -<br>2.1/1.3 | 1.40 | 1.2 | 0.62 | 0.22/0.18 | 0.80 | 0.99 | 1.23 |
| 11 | 0.8 | 0.31 | 0.9/0.4<br>- | 0.84 | 1.1 | 0.62 | 0.23/0.14 | 0.81 | 1.06 | 1.23 |
| 12 | 0.8 | 0.37 | 0.7/0.4<br>- | 0.80 | 0.3 | 0.61 | 0.24/0.17 | 0.77 | 1.01 | 1.27 |
| 13 | 0.8 | 0.33 | 0.6/0.5<br>- | 0.68 | 0.1 | 0.63 | 1.22/0.17 | 0.81 | 1.04 | 1.28 |
| 14 | 0.8 | 0.34 | 0.6/0.5<br>- | 0.62 | 0.1 | 0.57 | 0.21/0.17 | 0.78 | 1.02 | 1.30 |
| 15 | 0.8 | 0.28 | 0.7/0.4<br>- | 0.61 | | 0.62 | 0.23/0.17 | 0.82 | 0.97 | 1.17 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.28 | 0.6/0.4<br>- | 0.60 | | 0.60 | 0.25/0.18 | 0.81 | 1.02 | 1.20 |
| 17 | 0.8 | 0.23 | 0.7/0.5<br>- | 0.59 | | 0.59 | 0.21/0.19 | 0.86 | 0.99 | 1.17 |
| 18 | 0.8 | 0.21 | 0.7/0.6<br>2.0/1.5 | 0.83 | 0.8 | 0.60 | 0.24/0.18 | 0.85 | 1.02 | 1.18 |
| 19 | 0.8 | 0.09 | -<br>2.3/1.9 | 1.32 | 0.7 | 0.61 | 0.21/0.17 | 0.81 | 0.99 | 1.20 |
| 20 | 0.8 | 0.12 | -<br>2.3/1.8 | 1.78 | 1.2 | 0.61 | 0.19/0.16 | 0.80 | 1.05 | 1.23 |
| 21 | 0.8 | 0.18 | 0.9/0.7<br>2.0/1.7 | 1.56 | 1.1 | 0.61 | 0.22/0.18 | 0.86 | 1.01 | 1.22 |
| 22 | 0.8 | 0.20 | 0.8/0.7<br>2.0/1.5 | 1.00 | 1.0 | 0.60 | 0.22/0.15 | 0.79 | 1.09 | 1.27 |
| 23 | 0.8 | 0.17 | -<br>2.1/1.8 | 1.54 | 1.1 | 0.62 | 0.22/0.16 | 0.81 | 1.12 | 1.25 |
| 24 | 0.8 | 0.16 | -<br>2.0/1.4 | 1.49 | 1.0 | 0.60 | 0.31/0.16 | 0.81 | 0.99 | 1.25 |
| 25 | 0.8 | 0.14 | -<br>2.4/1.6 | 1.39 | 0.9 | 0.60 | 0.21/0.15 | 0.86 | 1.06 | 1.30 |
| 26 | 0.8 | 0.12 | -<br>3.4/1.6 | 1.41 | 1.1 | 0.61 | 0.22/0.15 | 0.78 | 1.05 | 1.30 |
| 27 | 0.8 | 0.17 | -<br>1.8/1.4 | 1.46 | 1.3 | 0.62 | 0.35/0.15 | 0.78 | 1.04 | 1.28 |
| 28 | 0.8 | 0.30 | 0.6/0.4<br>1.8/1.7 | 0.85 | 1.1 | 0.61 | 0.22/0.15 | 0.77 | 1.08 | 1.30 |
| 29 | 0.8 | 0.30 | 0.7/0.4<br>- | 0.58 | | 0.56 | 0.29/0.17 | 0.74 | 1.11 | 1.30 |
| 30 | 0.8 | 0.32 | 0.6/0.5<br>1.8/1.5 | 1.19 | 1.1 | 0.60 | 0.23/0.17 | 0.83 | 1.05 | 1.27 |
| 31 | 0.8 | 0.29 | -<br>2.0/1.4 | 1.68 | 1.1 | 0.59 | 0.20/0.15 | 0.83 | 1.07 | 1.22 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 3.1 : DISINFECTION PROFILE (mg/L) JANUARY 1984



WPOS - Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.31 | 0.7/0.3<br>2.1/1.2 | 0.68 | 0.6 | 0.61 | 0.24/0.19 | 0.78 | 0.82 | 1.02 |
| 2 | 0.8 | 0.26 | 0.7/0.3<br>1.9/1.3 | 1.09 | 0.8 | 0.62 | 0.24/0.17 | 0.78 | 0.83 | 1.00 |
| 3 | 0.8 | 0.27 | 0.7/0.4<br>2.0/1.0 | 0.70 | | 0.60 | 0.23/0.11 | 0.74 | 0.82 | 1.00 |
| 4 | 0.8 | 0.34 | 0.8/0.3<br>2.2/1.2 | 1.19 | 0.9 | 0.61 | 0.23/0.12 | 0.76 | 0.84 | 1.00 |
| 5 | 0.8 | 0.28 | 0.8/0.3<br>- | 0.70 | | 0.64 | 0.23/0.19 | 0.79 | 0.85 | 1.00 |
| 6 | 0.8 | 0.23 | 0.8/0.3<br>1.9/1.6 | 1.00 | 1.0 | 0.62 | 0.22/0.19 | 0.76 | 0.87 | 1.00 |
| 7 | 0.8 | 0.31 | 0.7/0.3<br>- | 0.67 | 0.3 | 0.58 | 0.21/0.19 | 0.76 | 0.84 | 0.95 |
| 8 | 0.8 | 0.31 | 0.5/0.3<br>- | 0.64 | | 0.61 | 0.22/0.17 | 0.75 | 0.84 | 0.93 |
| 9 | 0.8 | 0.23 | 0.6/0.4<br>1.8/1.0 | 0.85 | 0.7 | 0.61 | 0.24/0.20 | 0.72 | 0.83 | 0.97 |
| 10 | 0.8 | 0.29 | 0.8/0.4<br>1.6/1.3 | 0.97 | 0.8 | 0.61 | 0.25/0.19 | 0.76 | 0.85 | 1.00 |
| 11 | 0.8 | 0.30 | 0.7/0.4<br>- | 0.69 | 0.3 | 0.63 | 0.22/0.19 | 0.79 | 0.80 | 1.00 |
| 12 | 0.8 | 0.28 | 0.8/0.4<br>- | 0.65 | | 0.61 | 0.22/0.14 | 0.78 | 0.83 | 1.02 |
| 13 | 0.8 | 0.29 | 0.8/0.4<br>- | 0.66 | | 0.60 | 0.22/0.16 | 0.77 | 0.85 | 1.00 |
| 14 | 0.8 | 0.27 | 0.6/0.3<br>- | 0.64 | | 0.59 | 0.23/0.18 | 0.73 | 0.86 | 1.00 |
| 15 | 0.8 | 0.28 | 0.7/0.3<br>- | 0.65 | | 0.64 | 0.29/0.19 | 0.75 | 0.84 | 1.00 |

(1) Max./min. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 3.1 • (Cont'd) (mg/L) JANUARY 1984



| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.25 | 0.6/0.3<br>2.1/1.7 | 0.77 | 0.9 | 0.62 | 0.23/0.17 | 0.72 | 0.83 | 1.00 |
| 17 | 0.8 | 0.29 | 0.6/0.3<br>1.5/1.5 | 0.89 | 0.9 | 0.62 | 0.23/0.16 | 0.76 | 0.80 | 1.00 |
| 18 | 0.8 | 0.32 | 0.8/0.3<br>- | 0.67 | 0.1 | 0.63 | 0.23/0.17 | 0.75 | 0.80 | 1.00 |
| 19 | 0.8 | 0.30 | 0.7/0.4<br>2.9/1.6 | 0.91 | 1.0 | 0.62 | 0.27/0.18 | 0.77 | 0.79 | 0.97 |
| 20 | 0.8 | 0.38 | 0.7/0.3<br>- | 0.75 | 0.4 | 0.63 | 0.22/0.10 | 0.76 | 0.84 | 1.00 |
| 21 | 0.8 | 0.37 | 0.6/0.3<br>- | 0.64 | 0.1 | 0.59 | 0.22/0.18 | 0.72 | 0.86 | 1.00 |
| 22 | 0.8 | 0.34 | 0.6/0.3<br>1.9/1.4 | 0.86 | 0.8 | 0.61 | 0.22/0.19 | 0.70 | 0.85 | 1.00 |
| 23 | 0.8 | 0.32 | 0.7.0.3<br>- | 0.67 | | 0.61 | 0.23/0.12 | 0.70 | 0.84 | 1.00 |
| 24 | 0.8 | 0.31 | 0.7/0.3<br>- | 0.66 | | 0.62 | 0.25/0 | 0.66 | 0.81 | 1.00 |
| 25 | 0.8 | 0.45 | 0.7/0.3<br>4.0/1.0 | 1.04 | 1.2 | 0.62 | | 0.79 | 0.77 | 0.98 |
| 26 | 0.8 | 0.37 | 0.7/0.3<br>- | 0.70 | 0.4 | 0.61 | | 0.67 | 0.84 | 1.00 |
| 27 | 0.8 | 0.28 | 0.6/0.3<br>1.9/1.5 | 1.02 | 0.9 | 0.61 | | 0.80 | 0.79 | 1.02 |
| 28 | 0.8 | 0.19 | -<br>2.0/1.4 | 1.56 | 1.0 | 0.61 | | 0.79 | 0.81 | 1.02 |
| 29 | 0.8 | 0.21 | -<br>1.8/1.6 | 1.63 | 1.1 | 0.61 | | 0.79 | 0.70 | 0.93 |
| 30 | | | | | | | | | | |
| 31 | | | | | | | | | | |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 3.1 : DISINFECTION PROFILE (mg/L) APRIL 1984 

WPOS - Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.28 | 0.6/0.3<br>- | 0.65 | 0.4 | 0.53 | 0.18/0.15 | 0.73 | 0.76 | 0.97 |
| 2 | 0.8 | 0.33 | 0.5/0.3<br>- | 0.65 | 0.3 | 0.53 | 0.19/0.13 | 0.66 | 0.78 | 0.97 |
| 3 | 0.8 | 0.38 | 0.8/0.2<br>- | 0.66 | 0.2 | 0.51 | 0.20/0.13 | 0.65 | 0.82 | 0.93 |
| 4 | 0.8 | 0.36 | 0.6/0.3<br>- | 0.68 | 0.3 | 0.53 | 0.18/0.14 | 0.64 | 0.84 | 1.03 |
| 5 | 0.8 | 0.30 | 0.6/0.3<br>- | 0.64 | 0.4 | 0.51 | 0.19/0.15 | 0.62 | 0.84 | 0.98 |
| 6 | 0.8 | 0.27 | 0.7/0.2<br>- | 0.67 | 0.5 | 0.50 | 0.22/0.12 | 0.67 | 0.77 | 0.93 |
| 7 | 0.8 | 0.34 | 0.5/0.2<br>- | 0.62 | 0.3 | 0.51 | 0.19/0.15 | 0.65 | 0.93 | 1.07 |
| 8 | 0.8 | 0.32 | 0.5/0.2<br>- | 0.62 | 0.3 | 0.52 | 0.18/0.14 | 0.66 | 0.81 | 1.05 |
| 9 | 0.8 | 0.34 | 0.6/0.2<br>- | 0.64 | 0.3 | 0.51 | 0.23/0.15 | 0.63 | 0.79 | 0.97 |
| 10 | 0.8 | 0.32 | 0.7/0.3<br>- | 0.59 | 0.1 | 0.50 | 0.19/0.14 | 0.64 | 0.85 | 1.03 |
| 11 | 0.8 | 0.28 | 0.8/0.3<br>1.6/1.6 | 0.64 | 0.3 | 0.52 | 0.20/0.15 | 0.67 | 0.75 | 0.93 |
| 12 | 0.8 | 0.20 | 0.9/0.4<br>2.4/1.2 | 1.11 | 1.5 | 0.53 | 0.22/0.13 | 0.69 | 0.78 | 0.98 |
| 13 | 0.8 | 0.26 | 0.9/0.4<br>- | 0.66 | 0.4 | 0.51 | 0.20/0.14 | 0.69 | 0.85 | 1.05 |
| 14 | 0.8 | 0.26 | 0.9/0.4<br>- | 0.66 | 0.4 | 0.51 | 0.20/0.14 | 0.69 | 0.85 | 1.05 |
| 15 | 0.8 | 0.32 | 0.5/0.2<br>- | 0.65 | 0.4 | 0.51 | 0.17/0.15 | 0.65 | 0.87 | 1.08 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.31 | 0.5/0.3<br>- | 0.61 | 0.2 | 0.51 | 0.18/0.12 | 0.69 | 0.78 | 1.03 |
| 17 | 0.8 | 0.29 | 0.5/0.3<br>- | 0.58 | 0.2 | 0.51 | 0.23/0.12 | 0.68 | 0.80 | 0.95 |
| 18 | 0.8 | 0.28 | 0.5/0.3<br>- | 0.59 | 0.1 | 0.52 | 0.23/0.14 | 0.68 | 0.78 | 0.98 |
| 19 | 0.8 | 0.30 | 0.9/0.2<br>1.8/1.3 | 0.85 | 1.0 | 0.50 | 0.19/0.12 | 0.67 | 0.80 | 1.03 |
| 20 | 0.8 | 0.31 | 0.7/0.3<br>- | 0.72 | 0.5 | 0.51 | 0.19/0.16 | 0.62 | 0.88 | 1.12 |
| 21 | 0.8 | 0.29 | 0.7/0.4<br>- | 0.68 | 0.3 | 0.51 | 0.19/0.15 | 0.62 | 0.86 | 1.03 |
| 22 | 0.8 | 0.27 | 0.7/0.3<br>- | 0.62 | 0.3 | 0.50 | 0.19/0.15 | 0.65 | 0.87 | 1.00 |
| 23 | 0.8 | 0.32 | 0.7/0.3<br>- | 0.68 | 0.4 | 0.52 | 0.17/0.12 | 0.69 | 0.78 | 1.03 |
| 24 | 0.8 | 0.31 | 0.6/0.3<br>- | 0.67 | 0.3 | 0.51 | 0.19/0.15 | 0.67 | 0.78 | 0.97 |
| 25 | 0.8 | 0.29 | 0.3/0.4<br>- | 0.71 | 0.1 | 0.48 | 0.20/0.14 | 0.64 | 0.86 | 0.95 |
| 26 | 0.8 | 0.41 | 0.6/0.5<br>2.8/2.1 | 1.19 | 1.5 | 0.52 | 0.20/0.15 | 0.65 | 0.77 | 0.93 |
| 27 | 0.8 | 0.26 | 0.7/0.5<br>- | 0.67 | 0.3 | 0.49 | 0.20/0.13 | 0.71 | 0.77 | 0.98 |
| 28 | 0.8 | 0.27 | 1.0/0.4<br>- | 0.64 | 0.3 | 0.51 | 0.21/0.14 | 0.68 | 0.77 | 0.97 |
| 29 | 0.8 | 0.26 | 0.8/0.4<br>- | 0.62 | 0.3 | 0.51 | 0.19/0.15 | 0.68 | 0.78 | 0.98 |
| 30 | 0.8 | 0.30 | 0.7/0.3<br>- | 0.61 | 0.2 | 0.50 | 0.23/0.15 | 0.69 | 0.77 | 0.92 |
| 31 | | | | | | | | | | |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 3.1 : DISINFECTION PROFILE (mg/L) JULY 1984

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.26 | 0.8/0.4<br>- | 0.61 | 0.2 | 0.51 | 0.23/0.14 | 0.72 | 0.77 | 0.95 |
| 2 | 0.8 | 0.25 | 0.7/0.3<br>- | 0.63 | 0.2 | 0.50 | 0.19/0.14 | 0.68 | 0.80 | 0.98 |
| 3 | 0.8 | 0.26 | 0.6/0.4<br>- | 0.66 | 0.2 | 0.51 | 0.21/0.14 | 0.71 | 0.79 | 0.93 |
| 4 | 0.8 | 0.26 | 0.6/0.4<br>- | 0.64 | 0.2 | 0.49 | 0.18/0.14 | 0.71 | 0.75 | 0.97 |
| 5 | 0.8 | 0.26 | 0.8/0.4<br>2.4/1.6 | 0.76 | 1.1 | 0.53 | 0.21/0.13 | 0.73 | 0.77 | 0.97 |
| 6 | 0.8 | 0.26 | 0.6/0.3<br>1.8/1.1 | 1.28 | 1.4 | 0.52 | 0.19/0.13 | 0.67 | 0.82 | 1.05 |
| 7 | 0.8 | 0.29 | 0.7/0.3<br>- | 0.72 | 0.3 | 0.53 | 0.18/0.15 | 0.70 | 0.88 | 1.08 |
| 8 | 0.8 | 0.29 | 0.7/0.4<br>- | 0.67 | 0.3 | 0.54 | 0.20/0.15 | 0.72 | 0.87 | 1.08 |
| 9 | 0.8 | 0.25 | 0.7/0.4<br>1.9/1.2 | 0.64 | 0.2 | 0.51 | 0.27/0.11 | 0.69 | 0.92 | 1.15 |
| 10 | 0.8 | 0.21 | -<br>2.1/1.4 | 1.52 | 1.5 | 0.51 | 0.18/0.12 | 0.66 | 0.90 | 1.07 |
| 11 | 0.8/0 | 0.20 | -<br>2.4/1.4 | 2.02 | 1.3 | 0.51 | 0.19/0.07 | 0.65 | 1.04 | 1.23 |
| 12 | 0.8 | 0.20 | 0.7/0.6<br>2.1/1.2 | 1.48 | 1.3 | 0.52 | 0.20/0.15 | 0.69 | 0.93 | 1.23 |
| 13 | 0.8 | 0.28 | 0.7/0.4<br>- | 0.80 | 0.6 | 0.49 | 0.26/0.15 | 0.69 | 0.80 | 1.02 |
| 14 | 0.8 | 0.26 | 0.7/0.3<br>- | 0.67 | 0.3 | 0.51 | 0.19/0.16 | 0.65 | 0.81 | 0.95 |
| 15 | 0.8 | 0.26 | 1.2/0.3<br>- | 0.71 | 0.4 | 0.51 | 0.18/0.15 | 0.70 | 0.79 | 0.93 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min.
Super Post-Chlorination - max./min. (3) Max./min.

TABLE 3.1 (Cont'd) (mg/L) JULY 1984



| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.30 | 1.1/0.4<br>- | 0.86 | 0.6 | 0.51 | 0.19/0.15 | 0.66 | 0.83 | 0.93 |
| 17 | 0.8 | 0.27 | 1.3/0.4<br>1.8/1.6 | 0.79 | 0.6 | 0.49 | 0.19/0.12 | 0.68 | 0.95 | 1.12 |
| 18 | 0.8 | 0.26 | 0.7/0.4<br>1.9/1.0 | 0.99 | 1.3 | 0.51 | 0.19/0.14 | 0.66 | 1.05 | 1.23 |
| 19 | 0.8 | 0.26 | 0.6/0.3<br>- | 0.63 | 0.2 | 0.50 | 0.18/0.14 | 0.67 | 1.00 | 1.20 |
| 20 | 0.8 | 0.25 | 0.7/0.3<br>- | 0.64 | 0.5 | 0.55 | 0.21/0.14 | 0.69 | 1.02 | 1.20 |
| 21 | 0.8 | 0.26 | 0.7/0.2<br>- | 0.63 | 0.3 | 0.51 | 0.21/0.15 | 0.71 | 1.06 | 1.25 |
| 22 | 0.8 | 0.26 | 1.1/0.14<br>- | 0.76 | 0.6 | 0.52 | 0.19/0.14 | 0.75 | 0.92 | 1.10 |
| 23 | 0.8 | 0.24 | 0.8/0.4<br>1.9/1.5 | 0.82 | 0.9 | 0.50 | 0.19/0.15 | 0.72 | 0.96 | 1.13 |
| 24 | 0.8 | 0.25 | 1.4/0.5<br>- | 0.72 | 0.5 | 0.50 | 0.18/0.13 | 0.71 | 0.97 | 1.15 |
| 25 | 0.8 | 0.27 | 1.2/0.6<br>- | 0.92 | 0.6 | 0.49 | 0.21/0.13 | 0.72 | 0.96 | 1.13 |
| 26 | 0.8 | 0.25 | 1.1/0.3<br>- | 0.86 | 0.5 | 0.50 | 0.22/0.13 | 0.73 | 0.95 | 1.13 |
| 27 | 0.8 | 0.24 | 1.1/0.2<br>- | 0.64 | 0.2 | 0.48 | 0.22/1.14 | 0.71 | 0.98 | 1.17 |
| 28 | 0.8 | 0.21 | 0.9/0.7<br>2.3/1.3 | 1.14 | 1.1 | 0.52 | 0.17/0.14 | 0.74 | 0.94 | 1.12 |
| 29 | 0.8 | 0.23 | 0.9/0.4<br>1.9/1.5 | 1.37 | 1.3 | 0.51 | 0.19/0.14 | 0.69 | 0.95 | 1.10 |
| 30 | 0.8/0 | 0.18 | 0.9/0.8<br>2.7/1.6 | 1.45 | 1.5 | 0.50 | 0.19/0.13 | 0.71 | 0.96 | 1.10 |
| 31 | 0.8 | 0.16 | -<br>2.5/1.6 | 1.66 | 1.4 | 0.52 | 0.20/0.15 | 0.73 | 0.95 | 1.05 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. Super Post-Chlorination - max./min. (3) Max./min.

TABLE 3.1 • DISINFECTION PROFILE (mg/L) OCTOBER 1984 

• WPOS Toronto Easterly Filtration Plant

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION (3) | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 1 | 0.8 | 0.34 | 0.7/0.4<br>- | 0.64 | 0.2 | 0.55 | 0.19/0.15 | 0.72 | 1.00 | 1.18 |
| 2 | 0.8 | 0.30 | 0.8/0.4<br>- | 0.64 | | 0.60 | 0.23/0.17 | 0.85 | 1.00 | 1.18 |
| 3 | 0.8 | 0.29 | 0.9/0.5<br>- | 0.77 | 0.2 | 0.60 | 0.19/0.13 | 0.80 | 1.00 | 1.17 |
| 4 | 0.8 | 0.29 | 0.9/0.5<br>- | 0.74 | 0.1 | 0.60 | 0.20/0.14 | 0.75 | 0.98 | 1.20 |
| 5 | 0.8 | 0.23 | 0.8/0.6<br>2.8/1.8 | 0.73 | 1.0 | 0.61 | 0.22/0.10 | 0.75 | 1.03 | 1.20 |
| 6 | 0.8 | 0.24 | 0.9/0.3<br>2.0/1.6 | 1.20 | 1.0 | 0.61 | 0.23/0.18 | 0.74 | 1.00 | 1.20 |
| 7 | 0.8 | 0.28 | 0.9/0.5<br>- | 0.67 | 0.1 | 0.63 | 0.22/0.15 | 0.77 | 1.06 | 1.20 |
| 8 | 0.8 | 0.30 | 0.8/0.5<br>- | 0.67 | 0.1 | 0.59 | 0.19/0.17 | 0.76 | 0.95 | 1.20 |
| 9 | 0.8 | 0.29 | 0.8/0.4<br>- | 0.61 | 0.1 | 0.60 | 0.20/0.17 | 0.81 | 0.99 | 1.17 |
| 10 | 0.8 | 0.27 | 1.0/0.5<br>2.4/2.3 | 0.58 | | 0.59 | 0.24/0.17 | 0.79 | 1.00 | 1.20 |
| 11 | 0.8 | 0.21 | -<br>2.4/1.7 | 1.36 | 1.4 | 0.62 | 0.22/0.16 | 0.84 | 1.03 | 1.23 |
| 12 | 0.8 | 0.29 | 0.8/0.2<br>2.2/1.7 | 1.36 | 1.5 | 0.62 | 0.21/0.18 | 0.78 | 1.02 | 1.25 |
| 13 | 0.8 | 0.31 | 0.8/0.4<br>- | 0.68 | 0.4 | 0.60 | 0.25/0.17 | 0.76 | 1.00 | 1.20 |
| 14 | 0.8 | 0.28 | 1.0/0.5<br>- | 0.68 | 0.2 | 0.60 | 0.21/0.15 | 0.78 | 0.95 | 1.25 |
| 15 | 0.8 | 0.25 | 1.0/0.4<br>- | 0.64 | | 0.61 | 0.27/0.15 | 0.78 | 0.93 | 1.13 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 3.1 (Cont'd) (mg/L) OCTOBER 1984 

| DATE | PRE-CHLORINATION (1) | | POST-CHLORINATION (2) | | AFTER DECHLORINATION | | AFTER AMMONIATION | | FLUORIDE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $Cl_2$ Dos. | Free $Cl_2$ Res. | $Cl_2$ Dos. | Free $Cl_2$ Res. | $SO_2$ Dos. | Free $Cl_2$ Res. | $NH_3$ Dos. (3) | Tot. $Cl_2$ Res. | F Dos. | F Res. |
| 16 | 0.8 | 0.23 | 1.0/0.6<br>- | 0.62 | | 0.61 | 0.22/0.13 | 0.81 | 0.89 | 1.12 |
| 17 | 0.8 | 0.19 | 0.8/0.6<br>2.5/1.2 | 1.12 | 1.0 | 0.61 | 0.23/0.19 | 0.84 | 0.93 | 1.08 |
| 18 | 0.8 | 0.15 | -<br>2.3/1.4 | 1.38 | 1.0 | 0.60 | 0.21/0.17 | 0.79 | 1.02 | 1.13 |
| 19 | 0.8 | 0.15 | -<br>2.3/1.7 | 1.33 | 1.3 | 0.61 | 0.20/0.15 | 0.79 | 1.02 | 1.18 |
| 20 | 0.8 | 0.15 | -<br>2.3/1.5 | 1.47 | 1.0 | 0.61 | 0.24/0.15 | 0.85 | 0.96 | 1.12 |
| 21 | 0.8 | 0.15 | -<br>2.0/1.3 | 1.35 | 1.0 | 0.60 | 0.21/0.17 | 0.75 | 0.98 | 1.12 |
| 22 | 0.8 | 0.14 | -<br>2.0/1.4 | 1.30 | 0.9 | 0.60 | 0.27/0.17 | 0.80 | 0.91 | 1.10 |
| 23 | 0.8 | 0.14 | -<br>1.9/1.5 | 1.33 | 0.9 | 0.60 | 0.24/0.18 | 0.77 | 1.04 | 1.22 |
| 24 | 0.8 | 0.11 | -<br>3.3/1.8 | 1.45 | 1.3 | 0.63 | 0.20/0.15 | 0.78 | 1.04 | 1.26 |
| 25 | 0.8 | 0.10 | -<br>2.4/1.4 | 1.59 | 1.3 | 0.61 | 0.22/0.18 | 0.79 | 1.02 | 1.25 |
| 26 | 0.8 | 0.26 | 0.9/0.3<br>2.5/1.5 | 0.90 | 0.9 | 0.59 | 0.22/0 | 0.63 | 0.97 | 1.08 |
| 27 | 0.8 | 0.18 | 0.6/0.4<br>3.1/1.6 | 0.94 | 1.0 | 0.60 | | 0.79 | 1.03 | 1.20 |
| 28 | 0.8 | 0.16 | -<br>2.1/1.5 | 1.47 | 1.0 | 0.61 | | 0.84 | 1.00 | 1.20 |
| 29 | 0.8 | 0.17 | -<br>2.7/1.4 | 1.56 | 1.0 | 0.62 | 0.25/0 | 0.79 | 0.91 | 1.20 |
| 30 | 0.8 | 0.22 | -<br>2.1/1.2 | 1.52 | 1.4 | 0.61 | 0.20/0.16 | 0.78 | 0.94 | 1.12 |
| 31 | 0.8 | 0.21 | -<br>2.3/1.7 | 1.50 | 1.2 | 0.62 | 0.20/0.17 | 0.75 | 0.98 | 1.13 |

(1) Max./min. avg. (2) Ordinary Post-Chlorination - max./min. (3) Max./min.
Super Post-Chlorination - max./min.

TABLE 4

WATER PLANT OPTIMIZATION STUDY
"WATER QUALITY SUMMARY"

TABLE 4.0 • WATER QUALITY - 1-YEAR SUMMARY



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1986 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| GENERAL CHEMISTRY | | | | | | | | | | | | | |
| Alkalinity (pH 4.9) | R | 91 | 91 | 90 | 93 | 92 | 90 | 88 | 83 | 90 | 92 | 89 | 91 |
| mg/L | T | 86 | 85 | 84 | 87 | 88 | 82 | 82 | 75 | 84 | 87 | 84 | 84 |
| Ammonia - N Total | R | | | | | | | | | | | | |
| mg/L | T | | | | | | | | | | | | |
| Calcium - Ca | R | 39 | 38 | 39 | 39 | 39 | 41 | 42 | 40 | 39 | 39 | 40 | 40 |
| mg/L | T | 38 | 37 | 39 | 39 | 40 | 42 | 41 | 40 | 39 | 40 | 39 | 40 |
| Chloride - Cl | R | 24 | 24 | 24 | 25 | 24 | 24 | 25 | 24 | 24 | 24 | 24 | 23 |
| mg/L | T | 27 | 26 | 26 | 26 | 26 | 25 | 26 | 27 | 25 | 26 | 26 | 25 |
| Colour ACU | R | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| TCU | T | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Conductivity | R | 309 | 325 | 331 | 330 | 325 | 314 | 330 | 324 | 328 | 320 | 320 | 327 |
| µmho/cm | T | 317 | 340 | 337 | 333 | 332 | 319 | 338 | 335 | 338 | 330 | 324 | 334 |
| Fluoride - F | R | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 | 0.13 | 0.13 | 0.13 | 0.12 |
| mg/L | T | 1.13 | 1.21 | 1.20 | 1.20 | 1.20 | 1.15 | 1.16 | 1.12 | 1.24 | 1.26 | 1.18 | 1.20 |
| Hardness Total-$CaCO_3$ | R | 131 | 132 | 131 | 132 | 132 | 131 | 131 | 129 | 131 | 131 | 129 | 132 |
| mg/L | T | 131 | 131 | 131 | 132 | 131 | 131 | 130 | 128 | 130 | 131 | 129 | 130 |

TABLE 4.0 • (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1986 JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Magnesium - Mg | R | 8.4 | 8.4 | 8.1 | 8.1 | 8.2 | 8.2 | 8.2 | 8.2 | 8.1 | 8.1 | 8.1 | 7.5 |
| mg/L | T | 8.3 | 8.4 | 8.0 | 8.1 | 8.2 | 8.2 | 8.1 | 8.2 | 8.1 | 8.1 | 8.1 | 7.5 |
| Nitrate - N | R | 0.444 | 0.515 | 0.592 | 0.518 | 0.453 | 0.538 | 0.655 | 0.370 | 0.340 | 0.541 | 0.495 | 0.772 |
| mg/L | T | 0.626 | 0.710 | 0.625 | 0.470 | 0.469 | 0.507 | 0.710 | 0.535 | 0.269 | 0.604 | 0.565 | 0.303 |
| Nitrogen Free $NH_3$-N | R | 0.008 | 0.003 | 0.023 | 0.018 | 0.004 | 0.007 | 0.008 | 0.008 | 0.002 | 0.002 | 0.002 | 0.031 |
| mg/L | T | 0.105 | 0.110 | 0.111 | 0.093 | 0.095 | 0.092 | 0.100 | 0.093 | 0.097 | 0.102 | 0.101 | 0.099 |
| Nitrogen Organic-N* | <0.02 R | 0.288 | 0.180 | 0.030 | 0.183 | 0.367 | 0.171 | 0.165 | 0.405 | 0.395 | 0.241 | 0.246 | 0.336 |
| | >0.02 R | 0.106 | 0.154 | 0.323 | 0.244 | | 0.457 | 0.275 | 0.420 | | | 0.215 | 0.738 |
| mg/L | <0.02 T | 0.209 | 0.176 | 0.013 | 0.082 | 0.201 | 0.100 | 0.115 | 0.260 | 0.264 | 0.294 | 0.075 | 0.065 |
| | >0.02 T | 0.095 | 0.200 | 0.346 | 0.191 | | 0.270 | 0.210 | 0.300 | | | 0.280 | 0.329 |
| PH | R | 8.1 | 8.1 | 8.1 | 8.2 | 8.2 | 8.2 | 8.2 | 8.0 | 8.1 | 8.1 | 8.0 | 8.1 |
| | T | 7.6 | 7.6 | 7.6 | 7.6 | 7.7 | 7.5 | 7.5 | 7.4 | 7.6 | 7.6 | 7.6 | 7.5 |
| Phosphate - $PO_4$ Filt. | R | 0.015 | 0.016 | 0.011 | 0.010 | 0.028 | 0.032 | 0.042 | 0.022 | 0.030 | 0.012 | 0.005 | 0.006 |
| mg/L Susp. | R | | | | | 0.016 | 0.006 | 0.004 | 0.05 | 0.032 | 0.026 | 0.025 | 0.020 |
| Potassium - K | R | 1.3 | 1.3 | 1.4 | 1.5 | 1.5 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 |
| mg/L | T | 1.3 | 1.3 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| Silica-$SiO_2$ | R | | | | 0.65 | | 0.63 | | 0.30 | | 0.70 | | 0.70 |
| mg/L | T | | 0.105 | | 0.97 | | 0.95 | | 0.78 | | 1.15 | | 1.01 |

* Results shown for NH -N in raw water < 0.02 mg/L and > 0.02 mg/L

TABLE 4.0 - (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1986 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Sodium - Na | R | 12 | 12 | 13 | 14 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| mg/L | T | 12 | 13 | 13 | 14 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Sulphate - $SO_4$ | R | | | | 26 | | 25 | | 21 | | 28 | | 26 |
| mg/L | T | | 30 | | 29 | | 30 | | 25 | | 28 | | 27 |
| Total Solids | R | | | | | | | | | | | | |
| mg/L | T | | 188 | | | | | | 206 | | | | |
| Turbidity | R | 1.8 | 1.3 | 1.5 | 0.98 | 0.88 | 0.82 | 0.98 | 1.3 | 1.1 | 0.88 | 1.0 | 1.4 |
| FTU | T | 0.16 | 0.15 | 0.19 | 0.18 | 0.24 | 0.18 | 0.21 | 0.19 | 0.20 | 0.20 | 0.14 | 0.16 |
| METALS | | | | | | | | | | | | | |
| Aluminum - Al (Total) | R | 122 | 114 | 10 | 42 | 38 | 16 | 67 | 49 | 34 | 34 | 75 | 111 |
| µg/L (Filt.)* | T | 88 | 85 | 69 | 108 | 134/192 | 102 | 147/172 | 120/228 | 104 | 67 | 52 | 50 |
| Cadmium - Cd | R | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0.1 | 0 | 0 |
| µg/L | T | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.1 |
| Chromium - Cr | R | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| µg/L | T | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 1 |

* Filtered/Total

TABLE 4.0 : (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1986 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Copper - Cu | R | 2 | 1 | 2 | 2 | 5 | 2 | 22 | 5 | 0 | 25 | 12 | 27 |
| µg/L | T | 3 | 3 | 3 | 5 | 6 | 3 | 74 | 6 | 1 | 0 | 7 | 5 |
| Iron - Fe (Total) | R | 45 | 64 | 62 | 47 | 20 | 11 | 20 | 9 | 15 | 54 | 132 | 239 |
| µg/L (Total) | T | 1 | 2 | 7 | 5 | 18 | 3 | 9 | 2 | 1 | 4 | 4 | 7 |
| Lead - Pb | R | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 3 | 0 |
| µg/L | T | 0 | 1 | 2 | 2 | 1 | 3 | 2 | 0 | 0 | 0 | 3 | 1 |
| Manganese - Mn | R | 4 | 5 | 0 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 3 | 2 |
| µg/L | T | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 1 |
| Zinc - Zn | R | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| µg/L | T | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| DISSOLVED GASSES | | | | | | | | | | | | | |
| Carbon Dioxide - $CO_2$ | R | | | | | | | | | | | | |
| mg/L | T | | 7.8 | | | | | | 9.3 | | | | |
| Oxygen - $O_2$ | R | 95 | 92 | 89 | 104 | 104 | 101 | 87 | 84 | 92 | 95 | 94 | 97 |
| % Satrn. | T | 96 | 94 | 92 | 108 | 107 | 102 | 91 | 93 | 94 | 97 | 96 | 101 |

WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1986 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| SURROGATE ORGANICS | | | | | | | | | | | | | |
| Oxygen Demand-Biochem. | R | 1.7 | 1.2 | 1.8 | 2.2 | 2.4 | 2.4 | 0.2 | 2.7 | 1.1 | 0.7 | 2.0 | 0.8 |
| mg/L | | | | | | | | | | | | | |
| Oxygen Demand-Chemical | R | 6.9 | 5.2 | 7.3 | 9.9 | 9.9 | 7.7 | 5.3 | 4.2 | 6.5 | 6.1 | 6.5 | 3.8 |
| mg/L | T | 5.9 | 4.6 | 4.9 | 7.6 | 6.3 | 4.5 | 3.2 | 2.5 | 7.1 | 7.0 | 4.4 | 4.6 |
| Organic Carbon-Total | R | 1.9 | 1.8 | 2.0 | 2.3 | 1.9 | 2.0 | 2.0 | 2.1 | 2.0 | 1.6 | 1.9 | 2.0 |
| mg/L | T | 1.8 | 1.9 | 1.8 | 1.7 | 1.8 | 1.9 | 1.9 | 2.0 | 2.1 | 1.6 | 1.9 | 1.9 |
| PURGEABLE ORGANICS | | | | | | | | | | | | | |
| Bromoform | R | 0 | | 0 | | | | 0 | | 0 | | 0 | |
| µg/L | T | 0 | | 0 | | | | <MDL | | <MDL | | <MDL | |
| Bromodichloromethane | R | 0 | | 0 | | 0 | | 0 | | 0 | | <MDL | |
| µg/L | T | 2.8 | | 3.2 | | 3.9 | | 4.6 | | 3.9 | | 4.4 | |
| Chlorodibromomethane | R | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | |
| µg/L | T | 2.0 | | 2.0 | | 2.0 | | 3.0 | | 2.9 | | 3.0 | |
| Chloroform | R | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | |
| µg/L | T | 2.6 | | 4.6 | | 3.7 | | 4.3 | | 3.4 | | 6.6 | |

MDL denotes Minimum Detection Limit

TABLE 4.0 • (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1986 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Total Trihalomethane | R | 0 | | 0 | | 0 | | 0 | | 0 | | <MDL | |
| µg/L | T | 7.4 | | 9.8 | | 9.6 | | 11.9 | | 10.2 | | 14.0 | |
| Phenol | R | 0.2 | 0.2 | 0.1 | 0.3 | 0.7 | 0 | 0 | 0 | 0.04 | 0.04 | 0.5 | 0.1 |
| µg/L | T | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BACTERIA | | | | | | | | | | | | | |
| RAW WATER: | | | | | | | | | | | | | |
| Total Coliform MF Count/100 mL | R | 33 | 27 | 28 | 5.8 | 5.8 | 6.5 | 6.6 | 37 | 63 | 62 | 57 | 207 |
| Fecal Coliform MF Count/100 mL | R | 1.8 | 1.6 | 3.5 | 0.8 | 0.4 | 0.3 | 0.6 | 2.8 | 6.2 | 5.4 | 3.0 | 9.3 |
| Standard Plate Count MF Count/1 mL | R | 19 | 19 | 33 | 7.9 | 12 | 10 | 6.1 | 29 | 44 | 37 | 44 | 86 |
| TREATED WATER: | | | | | | | | | | | | | |
| Total Coliform MF Count/100 mL | T | 0 | 0 | 0 | 0 | 0 | 0.0038 | 0.0037 | 0 | 0.0076 | 0.0037 | 0 | 0 |

MDL denotes Minimum Detection Limit

| PARAMETER | | 1986 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| TREATED WATER (Cont'd) | | | | | | | | | | | | | |
| Fecal Coliform MF Count/100 mL | T | | | | | | 0 | 0 | | 0 | 0 | | |
| Standard Plate Count MF Count/1 mL | T | 0.083 | 0.066 | 0.091 | 0.12 | 0.073 | 0.063 | 0.038 | 0.21 | 0.11 | 0.092 | 0.13 | 0.077 |
| Fecal Streptococcus MF Count/1 mL | T | | | | | | | | | | | | |

WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1985 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Sodium - Na | R | 12 | 13 | 14 | 13 | 13 | 12 | 12 | 11 | 12 | 12 | 11 | 12 |
| mg/L | T | 12 | 13 | 14 | 13 | 13 | 12 | 12 | 11 | 12 | 12 | 12 | 12 |
| Sulphate - $SO_4$ | R | | | | | | | | | | | | |
| mg/L | T | | 34 | | 30 | | 31 | | 29 | | 30 | | 31 |
| Total Solids | R | | | | | | | | | | | | |
| mg/L | T | | 189 | | | | | | 212 | | | | |
| Turbidity | R | 1.5 | 1.0 | 2.3 | 2.6 | 1.1 | 1.0 | 1.2 | 1.2 | 1.2 | 0.78 | 1.9 | 1.6 |
| FTU | T | 0.16 | 0.17 | 0.17 | 0.19 | 0.27 | 0.26 | 0.24 | 0.23 | 0.22 | 0.16 | 0.22 | 0.21 |
| METALS | | | | | | | | | | | | | |
| Aluminum - Al (Total) | R | 178 | 144 | 170 | 227 | 152 | 61 | 70 | 71 | 149 | 25 | 60 | 80 |
| µg/L(Filtered)* | T | 73/292 | 91/284 | 84 | 129 | 140 | 144 | 131 | 148/184 | 136/165 | 121/200 | 132/155 | 99 |
| Cadmium - Cd | R | | | | | | | 0 | 0 | 0.3 | 0.4 | 0.2 | 0.4 |
| µg/L | T | | | | | | | 0 | 0 | 0.3 | 0.3 | 0 | 0.1 |
| Chromium - Cr | R | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| µg/L | T | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

* Filtered/Total

TABLE 4.0 • (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1985 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Copper - Cu | R | 1 | 2 | 2 | 2 | 14 | 5 | 4 | 5 | 2 | 1 | 4 | 0 |
| µg/L | T | 6 | 5 | 11 | 8 | 8 | 8 | 6 | 4 | 2 | 2 | 0 | 7 |
| Iron - Fe (Total) | R | 102 | 18 | 120 | 102 | 39 | 16 | 32 | 300 | 47 | 9 | 72 | 40 |
| µg/L (Total) | T | 4 | 5 | 13 | 6 | 3 | 1 | 6 | 25 | 44 | 3 | 14 | 7 |
| Lead - Pb | R | 3 | 3 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| µg/L | T | 3 | 2 | 1 | 0 | 1 | 1 | 1 | 1 | 3 | 2 | 0 | 0 |
| Manganese - Mn | R | 4 | 1 | 6 | 4 | 2 | 2 | 1 | 1 | 3 | 0 | 1 | 1 |
| µg/L | T | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Zinc - Zn | R | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 |
| µg/L | T | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DISSOLVED GASSES | | | | | | | | | | | | | |
| Carbon Dioxide - $CO_2$ | R | | | | | | | | | | | | |
| mg/L | T | | 5.5 | | | | | | 5.6 | | | | |
| Oxygen - $O_2$ | R | 92 | 94 | 98 | 103 | 96 | 100 | 101 | 87 | 92 | 95 | 93 | 92 |
| % Satrn. | T | 98 | 97 | 101 | 104 | 107 | 104 | 105 | 91 | 92 | 99 | 99 | 97 |

WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1985 JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SURROGATE ORGANICS | | | | | | | | | | | | | |
| Oxygen Demand-Biochem. | R | 0.5 | 0.6 | 0.3 | 0.4 | 1.3 | 0.8 | 1.0 | 0.5 | 0.6 | 0.25 | 0.8 | 1.1 |
| mg/L | | | | | | | | | | | | | |
| Oxygen Demand-Chemical | R | 5.5 | 7.9 | 9.8 | 11 | 6.3 | 7.0 | 6.6 | 7.1 | 5.8 | 5.9 | 7.3 | 4.8 |
| mg/L | T | 4.7 | 7.8 | 5.9 | 7.1 | 5.4 | 5.6 | 4.1 | 5.8 | 4.1 | 6.3 | 6.5 | 6.4 |
| Organic Carbon-Total | R | 1.7 | 1.4 | 1.9 | 2.1 | 1.9 | 1.8 | 1.8 | 2.0 | 1.9 | 1.7 | 2.1 | 1.9 |
| mg/L | T | 1.5 | 1.4 | 1.8 | 1.8 | 2.0 | 1.7 | 1.8 | 2.0 | 1.8 | 1.7 | 1.9 | 1.9 |
| PURGEABLE ORGANICS | | | | | | | | | | | | | |
| Bromoform | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Bromodichloromethane | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Chlorodibromomethane | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Chloroform | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |

TABLE 4.0 : (Cont'd)

WPOS - Toronto Easterly Filtration Plant



| PARAMETER | | 1985 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Total Trihalomethane | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Phenol | R | 0.1 | 0 | 0.1 | 0.1 | 0.3 | 0.1 | 0.1 | 0.04 | 0.09 | 0 | 0.1 | 0 |
| µg/L | T | 0 | 0 | 0.4 | 0 | 0.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BACTERIA | | | | | | | | | | | | | |
| RAW WATER: | | | | | | | | | | | | | |
| Total Coliform MF Count/100 mL | R | 58 | 52 | 46 | 14 | 14 | 13 | 19 | 20 | 21 | 98 | 192 | 213 |
| Fecal Coliform MF Count/100 mL | R | 5.4 | 3.9 | 5.7 | 0.86 | 0.29 | 0.38 | 1.3 | 1.9 | 3.6 | 9.3 | 16 | 17 |
| Standard Plate Count MF Count/1 mL | R | 24 | 29 | 34 | 13 | 6.9 | 8.2 | 13 | 26 | 20 | 46 | 85 | 67 |
| TREATED WATER: | | | | | | | | | | | | | |
| Total Coliform MF Count/100 mL | T | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.011 | 0 | 0 |

| PARAMETER | | 1985 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| TREATED WATER (Cont'd) | | | | | | | | | | | | | |
| Fecal Coliform MF Count/100 mL | T | | | | | | | | | | 0 | | |
| Standard Plate Count MF Count/1 mL | T | 0.30 | 0.078 | 0.13 | 0.095 | 0.17 | 0.11 | 0.13 | 0.11 | 0.062 | 0.070 | 0.10 | 0.21 |
| Fecal Streptococcus MF Count/1 mL | T | | | | | | | | | | | | |

TABLE 4.0 • WATER QUALITY - 1-YEAR SUMMARY



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1984 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| GENERAL CHEMISTRY | | | | | | | | | | | | | |
| Alkalinity (pH 4.9) | R | 90 | 90 | 88 | 88 | 91 | 89 | 94 | 93 | 91 | 89 | 94 | 93 |
| mg/L | T | 86 | 85 | 84 | 82 | 83 | 85 | 88 | 83 | 85 | 85 | 88 | 88 |
| Ammonia - N Total | R | | | | | | | | | | | | |
| mg/L | T | | | | | | | | | | | | |
| Calcium - Ca | R | 42 | 42 | 41 | 41 | 40 | 40 | 41 | 39 | 40 | 40 | 39 | 38 |
| mg/L | T | 42 | 42 | 41 | 41 | 41 | 40 | 41 | 39 | 40 | 40 | 40 | 38 |
| Chloride - Cl | R | 26 | 26 | 26 | 25 | 26 | 25 | 24 | 24 | 24 | 25 | 24 | 25 |
| mg/L | T | 27 | 27 | 28 | 29 | 28 | 27 | 26 | 27 | 27 | 26 | 26 | 28 |
| Colour ACU | R | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 3 |
| TCU | T | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Conductivity | R | 310 | 318 | 320 | 320 | 315 | 325 | 335 | 329 | 341 | 338 | 318 | 348 |
| µmho/cm | T | 318 | 320 | 328 | 315 | 320 | 328 | 347 | 337 | 340 | 345 | 332 | 331 |
| Fluoride - F | R | 0.13 | 0.13 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| mg/L | T | 0.99 | 0.96 | 1.00 | 1.00 | 0.97 | 0.95 | 1.09 | 1.13 | 1.14 | 1.18 | 1.15 | 1.20 |
| Hardness Total-$CaCO_3$ | R | 131 | 131 | 131 | 131 | 131 | 132 | 132 | 130 | 131 | 128 | 131 | 131 |
| mg/L | T | 131 | 131 | 131 | 131 | 130 | 131 | 131 | 130 | 132 | 129 | 131 | 130 |

TABLE 4.0 • (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1984 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Magnesium - Mg | R | 7.8 | 8.4 | 7.8 | 8.1 | 8.0 | 8.0 | 7.9 | 8.1 | 8.0 | 8.2 | 8.1 | 7.8 |
| mg/L | T | 7.7 | 8.3 | 7.8 | 8.0 | 8.0 | 8.0 | 7.9 | 8.0 | 8.0 | 8.3 | 8.1 | 7.8 |
| Nitrate - N | R | 0.586 | 0.231 | 0.256 | 0.350 | 0.271 | 0.275 | 0.227 | 0.394 | 0.385 | 0.480 | 0.400 | 0.120 |
| mg/L | T | 0.592 | 0.319 | 0.320 | 0.430 | 0.315 | 0.350 | 0.152 | 0.355 | 0.362 | 0.540 | 0.550 | 0.320 |
| Nitrogen Free $NH_3$-N | R | 0.006 | 0.010 | 0.005 | 0.001 | 0.013 | 0.007 | 0.008 | 0.032 | 0.009 | 0.015 | 0.019 | 0.010 |
| mg/L | T | 0.072 | 0.096 | 0.102 | 0.108 | 0.118 | 0.115 | 0.116 | 0.107 | 0.101 | 0.105 | 0.131 | 0.126 |
| Nitrogen Organic-N* <0.02 | R | 0.280 | 0.321 | 0.427 | 0.284 | | 0.190 | 0.129 | 0.439 | 0.075 | 0.305 | 0.245 | 0.153 |
| >0.02 | R | | 0.553 | | | 0.206 | | 0.154 | 0.664 | | | 0.168 | 0.295 |
| mg/L <0.02 | T | 0.185 | 0.184 | 0.236 | 0.265 | - | 0.180 | 0.324 | 0.095 | 0.005 | 0.203 | 0.310 | 0.168 |
| >0.02 | T | | 0.113 | | | 0.213 | | 0.094 | 0.349 | | | 0.235 | 0.158 |
| PH | R | 8.1 | 8.0 | 8.0 | 8.1 | 8.2 | 8.2 | 8.2 | 8.1 | 8.1 | 8.2 | 8.2 | 8.1 |
| | T | 7.6 | 7.6 | 7.5 | 7.4 | 7.5 | 7.6 | 7.5 | 7.5 | 7.5 | 7.6 | 7.6 | 7.6 |
| Phosphate - $PO_4$ TOTAL | R | 0.015 | 0.018 | 0.004 | 0.019 | 0.009 | 0.019 | 0.013 | 0.009 | 0.010 | 0.009 | 0.012 | 0.005 |
| mg/L | | | | | | | | | | | | | |
| Potassium - K | R | 1.3 | 1.6 | 1.6 | 1.6 | 1.8 | 1.9 | 1.6 | 1.4 | 1.4 | 1.5 | 1.5 | 1.3 |
| mg/L | T | 1.3 | 1.6 | 1.5 | 1.5 | 1.8 | 1.8 | 1.6 | 1.4 | 1.4 | 1.5 | 1.5 | 1.2 |
| Silica-$SiO_2$ | R | | | | | | | | | | | | |
| mg/L | T | | 1.16 | | 1.00 | | 0.80 | | 0.94 | | 0.95 | | 1.26 |

* Results shown for NH -N in raw water <0.02 mg/L and >0.02 mg/L

TABLE 4.0 - (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1984 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Sodium - Na | R | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 13 | 13 | 12 | 13 | 12 |
| mg/L | T | 12 | 12 | 14 | 13 | 13 | 13 | 12 | 13 | 13 | 12 | 13 | 13 |
| Sulphate - $SO_4$ | R | | | | | | | | | | | | |
| mg/L | T | | 28 | | 28 | | 29 | | 30 | | 29 | | 28 |
| Total Solids | R | | | | | | | | | | | | |
| mg/L | T | | | | 189 | | | | | | 198 | | |
| Turbidity | R | 1.3 | 1.8 | 1.7 | 1.4 | 0.87 | 0.97 | 1.1 | 1.5 | 1.2 | 0.87 | 1.2 | 1.9 |
| FTU | T | 0.28 | 0.18 | 0.11 | 0.12 | 0.13 | 0.12 | 0.13 | 0.14 | 0.17 | 0.22 | 0.20 | 0.15 |
| METALS | | | | | | | | | | | | | |
| Aluminum - Al (Total) | R | 7 | 4 | 13 | 16 | 5 | 27 | 40 | 7 | 10 | 42 | 161 | 98 |
| µg/L (Total) | T | 11 | 4 | 8 | 10 | 45 | 100 | 88 | 131 | 106 | 107 | 91 | 75 |
| Cadmium - Cd | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Chromium - Cr | R | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 3 | 0 | 0 |
| µg/L | T | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 0 |

TABLE 4.0 • (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1984 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Copper - Cu | R | 0 | 2 | 0 | 0 | 2 | 4 | 1 | 2 | 2 | 2 | 2 | 2 |
| µg/L | T | 16 | 21 | 22 | 21 | 18 | 16 | 12 | 10 | 5 | 4 | 4 | 2 |
| Iron - Fe (Total) | R | 5 | 140 | 74 | 49 | 26 | 40 | 25 | 1 | 10 | 31 | 70 | 47 |
| µg/L (Total) | T | 14 | 25 | 26 | 32 | 31 | 39 | 26 | 8 | 6 | 33 | 3 | 3 |
| Lead - Pb | R | 0 | 3 | 0 | 1 | 2 | 1 | 1 | 4 | 6 | 2 | 2 | 2 |
| µg/L | T | 0 | 2 | 1 | 1 | 2 | 3 | 2 | 6 | 2 | 3 | 2 | 2 |
| Manganese - Mn | R | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 3 | 4 |
| µg/L | T | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Zinc - Zn | R | 0 | 2 | 2 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 1 |
| µg/L | T | 0 | 3 | 8 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| <u>DISSOLVED GASSES</u> | | | | | | | | | | | | | |
| Carbon Dioxide - $CO_2$ | R | | | | | | | | | | | | |
| mg/L | T | | | | 9.5 | | | | | | 4.0 | | |
| Oxygen - $O_2$ | R | 93 | 99 | 95 | 102 | 105 | 103 | 100 | 93 | 84 | 98 | 90 | 92 |
| % Satrn. | T | 99 | 102 | 100 | 105 | 106 | 106 | 104 | 100 | 95 | 100 | 91 | 94 |

TABLE 4.0 • (Cont'd)



WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1984 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| SURROGATE ORGANICS | | | | | | | | | | | | | |
| Oxygen Demand-Biochem. | R | 0.7 | 1.3 | 0.7 | 1.1 | 1.2 | 0.3 | 0.8 | 0.6 | 0.7 | 0.9 | 0.8 | 1.7 |
| mg/L | | | | | | | | | | | | | |
| Oxygen Demand-Chemical | R | 5.3 | 6.7 | 5.9 | 9.5 | 5.8 | 7.4 | 8.6 | 7.8 | 6.2 | 9.3 | 7.4 | 7.5 |
| mg/L | T | 4.4 | 6.1 | 4.9 | 6.9 | 9.2 | 7.9 | 5.7 | 5.2 | 3.9 | 7.7 | 7.4 | 10.3 |
| Organic Carbon-Total | R | | | | | | 1.9 | 1.9 | 2.1 | 2.3 | 1.8 | 2.0 | 2.0 |
| mg/L | T | | | | | | 2.0 | 1.7 | 2.0 | 1.8 | 2.0 | 1.8 | 1.7 |
| PURGEABLE ORGANICS | | | | | | | | | | | | | |
| Bromoform | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Bromodichloromethane | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Chlorodibromomethane | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Chloroform | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |

TABLE 4.0 : (Cont'd)

WPOS - Toronto Easterly Filtration Plant



| PARAMETER | | 1984 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| Total Trihalomethane | R | | | | | | | | | | | | |
| µg/L | T | | | | | | | | | | | | |
| Phenol | R | 0.2 | 0.2 | 0.5 | 0.3 | 0.3 | 0.4 | 0.6 | 0.7 | 0.4 | 0.3 | 0.04 | 0 |
| µg/L | T | 0 | 0 | 0.4 | 0 | 0.5 | 0 | 0 | 0 | 0 | 0 | 0.1 | 0 |
| BACTERIA | | | | | | | | | | | | | |
| RAW WATER: | | | | | | | | | | | | | |
| Total Coliform MF Count/100 mL | R | 73 | 153 | 5.4 | 7.6 | 4.6 | 18 | 19 | 26 | 19 | 33 | 68 | 42 |
| Fecal Coliform MF Count/100 mL | R | 14 | 35 | 0.27 | 1.5 | 0.056 | 1.1 | 1.0 | 3.2 | 2.8 | 4.1 | 13 | 5.3 |
| Standard Plate Count MF Count/1 mL | R | 20 | 54 | 12 | 13 | 5.2 | 13 | 17 | 22 | 22 | 12 | 41 | 16 |
| TREATED WATER: | | | | | | | | | | | | | |
| Total Coliform MF Count/100 mL | T | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 4.0 • (Cont'd) 

WPOS - Toronto Easterly Filtraiton Plant

| PARAMETER | 1984 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC |
| TREATED WATER (Cont'd) | | | | | | | | | | | | |
| Fecal Coliform MF T Count/100 mL | | | | | | | | | | | | |
| Standard Plate Count MF T Count/1 mL | 0.24 | 0.35 | 0.24 | 0.11 | 0.17 | 0.17 | 0.15 | 0.10 | 0.20 | 0.10 | 0.084 | 0.087 |
| Fecal Streptococcus MF T Count/1 mL | | | | | | | | | | | | |

# TABLE 4.1 • WATER QUALITY - 3-YEAR SUMMARY

WPOS - Toronto Easterly Filtration Plant

| PARAMETER | | 1986 | | | 1985 | | | 1984 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| GENERAL CHEMISTRY | | | | | | | | | | |
| Alkalinity (pH 4.9) | R | 93 | 83 | 90 | 97 | 89 | 92 | 94 | 88 | 91 |
| mg/L | T | 88 | 75 | 84 | 89 | 77 | 84 | 88 | 82 | 85 |
| Ammonia - N Total | R | | | | | | | | | |
| mg/L | T | | | | | | | | | |
| Calcium - Ca | R | 42 | 38 | 40 | 42 | 38 | 40 | 42 | 38 | 40 |
| mg/L | T | 42 | 37 | 40 | 41 | 38 | 40 | 42 | 38 | 40 |
| Chloride - Cl | R | 25 | 23 | 24 | 26 | 23 | 25 | 26 | 24 | 25 |
| mg/L | T | 27 | 25 | 26 | 27 | 25 | 26 | 29 | 26 | 27 |
| Colour ACU | R | 4 | 1 | 2 | 10 | 2 | 3 | 10 | 2 | 3 |
| TCU | T | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| Conductivity | R | 331 | 309 | 324 | 352 | 310 | 327 | 341 | 310 | 326 |
| μmho/cm | T | 340 | 317 | 331 | 343 | 318 | 333 | 347 | 318 | 330 |
| Fluoride - F | R | 0.14 | 0.11 | 0.13 | 0.15 | 0.12 | 0.14 | 0.15 | 0.12 | 0.13 |
| mg/L | T | 1.5 | 0.3 | 1.19 | 1.6 | 0.2 | 1.22 | 1.4 | 0.4 | 1.06 |
| Hardness Total-$CaCO_3$ | R | 132 | 129 | 131 | 131 | 128 | 130 | 132 | 128 | 131 |
| mg/L | T | 132 | 128 | 130 | 133 | 128 | 131 | 132 | 129 | 131 |

TABLE 4.1 • (Cont'd)



| PARAMETER | | 1986 Max. | 1986 Min. | 1986 Avg. | 1985 Max. | 1985 Min. | 1985 Avg. | 1984 Max. | 1984 Min. | 1984 Avg. |
|---|---|---|---|---|---|---|---|---|---|---|
| Magnesium - Mg | R | 8.4 | 7.5 | 8.1 | 8.6 | 7.9 | 8.3 | 8.4 | 7.8 | 8.0 |
| mg/L | T | 8.4 | 7.5 | 8.1 | 8.6 | 7.9 | 8.3 | 8.3 | 7.7 | 8.0 |
| Nitrate - N | R | 0.772 | 0.340 | 0.521 | 0.650 | 0.089 | 0.415 | 0.586 | 0.120 | 0.331 |
| mg/L | T | 0.710 | 0.303 | 0.533 | 0.754 | 0.050 | 0.399 | 0.592 | 0.152 | 0.384 |
| Nitrogen Free $NH_3$-N | R | 0.620 | 0 | 0.010 | 0.480 | 0 | 0.011 | 0.450 | 0 | 0.011 |
| mg/L | T | 0.170 | 0 | 0.100 | 0.210 | 0 | 0.116 | 0.200 | 0 | 0.108 |
| Nitrogen Organic-N* <0.02 | R | 0.405 | 0.030 | 0.251 | 0.625 | 0.129 | 0.416 | 0.439 | 0.075 | 0.259 |
| >0.02 | R | 0.738 | 0.106 | 0.331 | 0.805 | 0.138 | 0.343 | 0.664 | 0.154 | 0.340 |
| mg/L <0.02 | T | 0.294 | 0.013 | 0.155 | 0.600 | 0.071 | 0.262 | 0.324 | 0.005 | 0.196 |
| >0.02 | T | 0.346 | 0.095 | 0.247 | 1.046 | 0.115 | 0.272 | 0.349 | 0.094 | 0.194 |
| PH | R | 8.5 | 7.8 | 8.1 | 8.5 | 7.8 | 8.2 | 8.5 | 7.9 | 8.1 |
| | T | 7.8 | 7.3 | 7.6 | 7.8 | 7.3 | 7.6 | 7.8 | 7.2 | 7.5 |
| Phosphate - $PO_4$ Filt. | R | 0.042 | 0.005 | 0.019 | | | | | | |
| mg/L Total Susp. | R | 0.032 | 0.004 | 0.022 | 0.021 | 0.005 | 0.012 | 0.019 | 0.004 | 0.012 |
| Potassium - K | R | 1.5 | 1.3 | 1.4 | 1.5 | 1.3 | 1.4 | 1.9 | 1.3 | 1.5 |
| mg/L | T | 1.5 | 1.3 | 1.4 | 1.5 | 1.3 | 1.4 | 1.8 | 1.2 | 1.5 |
| Silica-$SiO_2$ | R | 0.70 | 0.30 | 0.60 | | | | | | |
| mg/L | T | 1.15 | 0.78 | 0.99 | 1.35 | 0.90 | 1.06 | 1.26 | 0.80 | 1.02 |

* Results shown for NH -N in raw water < 0.02 mg/L and > 0.02 mg/L

| PARAMETER | | 1986 | | | 1985 | | | 1984 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| Sodium Na | R | 14 | 12 | 12 | 14 | 11 | 12 | 13 | 12 | 13 |
| mg/L | T | 14 | 12 | 12 | 14 | 11 | 12 | 14 | 12 | 13 |
| Sulphate - $SO_4$ | R | 28 | 21 | 25 | | | | | | |
| mg/L | T | 30 | 25 | 28 | 29 | 34 | 31 | 30 | 28 | 29 |
| Total Solids | R | | | | | | | | | |
| mg/L | T | 206 | 188 | 197 | 212 | 189 | 201 | 198 | 189 | 194 |
| Turbidity | R | 9.3 | 0.31 | 1.2 | 20 | 0.30 | 1.4 | 16 | 0.30 | 1.3 |
| FTU | T | 0.45 | 0.07 | 0.18 | 0.45 | 0.10 | 0.21 | 0.41 | 0.06 | 0.16 |
| METALS | | | | | | | | | | |
| Aluminum - Al (Total) | R | 122 | 10 | 59 | 227 | 25 | 116 | 161 | 5 | 36 |
| µg/L (Total) | T | 421 | 24 | 158 | 248 | 27 | 126 | 545 | 4 | 65 |
| Cadmium - Cd | R | 0.1 | 0 | 0.03 | 0.4 | 0 | 0.2 | | | |
| µg/L | T | 0.1 | 0 | 0.02 | 0.3 | 0 | 0.1 | | | |
| Chromium Cr | R | 1 | 0 | 0.4 | 1 | 0 | 0 | 4 | 0 | 1 |
| µg/L | T | 2 | 0 | 0.5 | 0 | 0 | 0 | 2 | 0 | 1 |

TABLE 4.1 - (Cont'd)



| PARAMETER | | | 1986 | | | 1985 | | | 1984 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| Copper Cu | | R | 27 | 0 | 9 | 14 | 0 | 4 | 4 | 0 | 2 |
| | µg/L | T | 74 | 0 | 10 | 11 | 0 | 6 | 22 | 2 | 13 |
| Iron - Fe | | (1)R | 239 | 11 | 60 | 300 | 9 | 75 | 20 | 0 | 5 |
| | µg/L | (1)T | 18 | 1 | 5 | 44 | 1 | 11 | 35 | 1 | 6 |
| Lead - Pb | | R | 3 | 0 | 1 | 3 | 0 | 1 | 6 | 0 | 2 |
| | µg/L | T | 3 | 0 | 1 | 3 | 0 | 1 | 6 | 0 | 2 |
| Manganese - Mn | | R | 5 | 0 | 2 | 6 | 0 | 2 | 4 | 1 | 2 |
| | µg/L | T | 2 | 0 | 0.8 | 1 | 0 | 1 | 1 | 0 | 0 |
| Zinc - Zn | | R | 4 | 0 | 0.6 | 2 | 0 | 0 | 3 | 0 | 1 |
| | µg/L | T | 2 | 0 | 0.3 | 0 | 0 | 0 | 8 | 0 | 1 |
| DISSOLVED GASSES | | | | | | | | | | | |
| Carbon Dioxide - $CO_2$ | | R | | | | | | | | | |
| | mg/L | T | 9.3 | 7.8 | 8.6 | 5.6 | 5.5 | 5.6 | 9.5 | 4.0 | 6.8 |
| Oxygen - $O_2$ | | R | 104 | 84 | 95 | 103 | 87 | 95 | 105 | 84 | 96 |
| | % Satrn. | T | 108 | 91 | 98 | 107 | 91 | 100 | 106 | 91 | 100 |

(1) 1986, 1985 - Total
1984 - Filtered

| PARAMETER | | 1986 | | | 1985 | | | 1984 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| SURROGATE ORGANICS | | | | | | | | | | |
| Oxygen Demand-Biochem. | R | 2.4 | 0.2 | 1.6 | 1.3 | 0.3 | 0.7 | 1.7 | 0.3 | 0.9 |
| mg/L | | | | | | | | | | |
| Oxygen Demand-Chemical | R | 17 | 2.5 | 6.6 | 14 | 1.8 | 7.1 | 21 | 1.7 | 7.3 |
| mg/L | T | 14 | 0.4 | 5.2 | 12 | 1.8 | 5.8 | 15 | 0.9 | 6.6 |
| Organic Carbon-Total | R | 2.3 | 1.6 | 2.0 | 2.1 | 1.4 | 1.9 | 2.3 | 1.8 | 2.0 |
| mg/L | T | 2.1 | 1.6 | 1.9 | 2.0 | 1.4 | 1.8 | 2.0 | 1.7 | 1.9 |
| PURGEABLE ORGANICS | | | | | | | | | | |
| Bromoform | R | 0 | 0 | 0 | | | | | | |
| µg/L | T | <MDL | 0 | <MDL | | | | | | |
| Bromodichloromethane | R | <MDL | 0 | <MDL | | | | | | |
| µg/L | T | 4.6 | 2.8 | 3.8 | | | | | | |
| Chlorodibromomethane | R | 0 | 0 | 0 | | | | | | |
| µg/l | T | 3.0 | 2.0 | 2.6 | | | | | | |
| Chloroform | R | 0 | 0 | 0 | | | | | | |
| µg/l | T | 6.6 | 2.6 | 4.3 | | | | | | |

MDL denotes Minimum Detection Limit

TABLE 4.1 : (Cont'd)



| PARAMETER | | 1986 | | | 1985 | | | 1984 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| Total Trihalomethane | R | <MDL | 0 | <MDL | | | | | | |
| μg/L | T | 14.0 | 7.4 | 10.7 | | | | | | |
| Phenol | R | 3.6 | 0 | 0.2 | 2.5 | 0 | 0.09 | 3.3 | 0 | 0.3 |
| μg/L | T | 1.3 | 0 | 0.02 | 1.6 | 0 | 0.06 | 3 | 0 | 0.1 |
| **BACTERIA** | | | | | | | | | | |
| **RAW WATER:** | | | | | | | | | | |
| Total Coliform MF | R | 207 | 5.8 | 25 | 213 | 13 | 63 | 153 | 4.6 | 39 |
| Count/100 mL | | | | | | | | | | |
| Fecal Coliform MF | R | 9.3 | 0.3 | 1.9 | 17 | 0.29 | 5.5 | 35 | 0.056 | 6.8 |
| Count/100 mL | | | | | | | | | | |
| Standard Plate Count MF | R | 86 | 6.1 | 22 | 85 | 6.9 | 31 | 54 | 5.2 | 21 |
| Count/1 mL | | | | | | | | | | |
| **TREATED WATER:** | | | | | | | | | | |
| Total Coliform MF | T | 0.0076 | 0 | 0.002 | 0.011 | 0 | 0.00092 | 0 | 0 | 0 |
| Count/100 mL | | | | | | | | | | |

MDL denotes Minimum Detection Limit

| PARAMETER | 1986 | | | 1985 | | | 1984 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Avg. | Max. | Min. | Avg. | Max. | Min. | Avg. |
| TREATED WATER (Cont'd) | | | | | | | | | |
| Fecal Coliform MF T Count/100 mL | | | | | | | | | |
| Standard Plate Count MF T Count/1 mL | 0.21 | 0.038 | 0.088 | 0.30 | 0.062 | 0.13 | 0.35 | 0.084 | 0.17 |
| Fecal Streptococcus MF T Count/1 mL | | | | | | | | | |

# TABLE 5

## WATER PLANT OPTIMIZATION STUDY
## "PARTICULATE COUNTING, SUSPENDED SOLIDS AND ALGAE COUNTS"

# TABLE 6

## WATER PLANT OPTIMIZATION STUDY
## "BACTERIOLOGICAL TESTING"

TABLE 6.0 : BACTERIOLOGICAL TESTING 1986 Membrane Filter Method

WPOS - Toronto Easterly Filtration Plant



| MONTH | WATER | TOTAL COLIFORM | | | | FECAL COLIFORM | | | | FECAL STREPTOCOCCUS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. * | No. Tests | Max. | Min. | Avg. * | No. Tests | Max. | Min. | Avg. * | No. Tests |
| Jan. | R | 500 | 0 | 33 | 94 | 36 | 0 | 1.8 | 94 | | | | |
| | T | 0 | 0 | 0 | 171 | | | | | | | | |
| Feb. | R | 1600 | 0 | 27 | 85 | 38 | 0 | 1.6 | 85 | | | | |
| | T | 0 | 0 | 0 | 167 | | | | | | | | |
| Mar. | R | 4400 | 0 | 28 | 89 | 200 | 0 | 3.5 | 89 | | | | |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Apr. | R | 800 | 0 | 5.8 | 94 | 120 | 0 | 0.76 | 94 | | | | |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| May | R | 800 | 0 | 5.8 | 92 | 70 | 0 | 0.40 | 92 | | | | |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| June | R | 170 | 0 | 6.5 | 90 | 10 | 0 | 0.33 | 90 | | | | |
| | T | 1 | 0 | 0.004 | 179 | 0 | 0 | 0 | 2 | | | | |
| July | R | 440 | 0 | 6.6 | 96 | 19 | 0 | 0.63 | 96 | | | | |
| | T | 1 | 0 | 0.004 | 185 | 0 | 0 | 0 | 2 | | | | |
| Aug. | R | 1200 | 0 | 37 | 91 | 88 | 0 | 2.8 | 91 | | | | |
| | T | 0 | 0 | 0 | 185 | | | | | | | | |
| Sep. | R | 2500 | 0 | 63 | 92 | 80 | 0 | 6.2 | 92 | | | | |
| | T | 1 | 0 | 0.008 | 179 | 0 | 0 | 0 | 2 | | | | |
| Oct. | R | 2200 | 2 | 62 | 94 | 63 | 0 | 5.4 | 94 | | | | |
| | T | 1 | 0 | 0.004 | 181 | 0 | 0 | 0 | 10 | | | | |
| Nov. | R | 2500 | 0 | 57 | 66 | 140 | 0 | 3.0 | 66 | | | | |
| | T | 0 | 0 | 0 | 137 | | | | | | | | |
| Dec. | R | 3000 | 10 | 207 | 67 | 250 | 0 | 9.3 | 67 | | | | |
| | T | 0 | 0 | 0 | 195 | | | | | | | | |

* Geometric Mean for 1986

Coliform Group - Count/100mL
Streptococcus Group Count/1mL

# TABLE 6.0 : BACTERIOLOGICAL TESTING 1985 Membrane Filter Method

WPOS - Toronto Easterly Filtration Plant



| MONTH | WATER | TOTAL COLIFORM | | | | FECAL COLIFORM | | | | FECAL STREPTOCOCCUS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. * | No. Tests | Max. | Min. | Avg. * | No. Tests | Max. | Min. | Avg. * | No. Tests |
| Jan. | R | 500 | 0 | 58 | 94 | 66 | 0 | 5.4 | 94 | 0 | 0 | 0 | 18 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Feb. | R | 500 | 0 | 52 | 82 | 80 | 0 | 3.9 | 82 | 1 | 0 | 0.063 | 16 |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| Mar. | R | 800 | 0 | 46 | 93 | 59 | 0 | 5.7 | 93 | 1 | 0 | 0.056 | 18 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Apr. | R | 120 | 0 | 14 | 92 | 13 | 0 | 0.86 | 92 | 0 | 0 | 0 | 16 |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| May | R | 90 | 0 | 14 | 94 | 6 | 0 | 0.29 | 94 | 0 | 0 | 0 | 20 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| June | R | 130 | 0 | 13 | 91 | 11 | 0 | 0.38 | 91 | 0 | 0 | 0 | 16 |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| July | R | 200 | 0 | 19 | 96 | 20 | 0 | 1.3 | 96 | 0 | 0 | 0 | 16 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Aug. | R | 150 | 0 | 20 | 93 | 19 | 0 | 1.9 | 93 | 1 | 0 | 0.050 | 20 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Sep. | R | 300 | 0 | 21 | 91 | 13 | 0 | 3.6 | 91 | 0 | 0 | 0 | 16 |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| Oct. | R | 860 | 0 | 98 | 96 | 90 | 0 | 9.3 | 96 | | | | |
| | T | 1 | 0 | 0.011 | 185 | 0 | 0 | 0 | 2 | | | | |
| Nov. | R | 2400 | 0 | 192 | 89 | 160 | 0 | 16 | 89 | | | | |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| Dec. | R | 1800 | 0 | 213 | 87 | 100 | 0 | 17 | 87 | | | | |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |

* Geometric Mean for 1986

Coliform Group - Count/100mL
Streptococcus Group Count/1mL

TABLE 6.0 : BACTERIOLOGICAL TESTING 1984 Membrane Filter Method



| MONTH | WATER | TOTAL COLIFORM | | | | FECAL COLIFORM | | | | FECAL STREPTOCOCCUS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Avg. * | No. Tests | Max. | Min. | Avg. * | No. Tests | Max. | Min. | Avg. * | No. Tests |
| Jan. | R | 600 | 0 | 73 | 86 | 200 | 0 | 14 | 86 | 2 | 0 | 0.19 | 16 |
| | T | 0 | 0 | 0 | 121 | | | | | | | | |
| Feb. | R | 1900 | 0 | 153 | 82 | 400 | 0 | 35 | 82 | 2 | 0 | 0.11 | 12 |
| | T | 0 | 0 | 0 | 159 | | | | | | | | |
| Mar. | R | 39 | 0 | 5.4 | 94 | 7 | 0 | 0.27 | 94 | 0 | 0 | 0 | 20 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Apr. | R | 120 | 0 | 7.6 | 84 | 20 | 0 | 1.5 | 84 | 0 | 0 | 0 | 20 |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| May | R | 38 | 0 | 4.6 | 95 | 3 | 0 | 0.056 | 95 | 0 | 0 | 0 | 18 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| June | R | 170 | 0 | 18 | 91 | 16 | 0 | 1.1 | 91 | 0 | 0 | 0 | 18 |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| July | R | 240 | 0 | 19 | 94 | 15 | 0 | 1.0 | 94 | 0 | 0 | 0 | 16 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Aug. | R | 290 | 0 | 26 | 94 | 40 | 0 | 3.2 | 94 | 0 | 0 | 0 | 20 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Sep. | R | 230 | 0 | 19 | 88 | 120 | 0 | 2.8 | 88 | 1 | 0 | 0.063 | 16 |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| Oct. | R | 850 | 0 | 33 | 96 | 83 | 0 | 4.1 | 96 | 0 | 0 | 0 | 16 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |
| Nov. | R | 460 | 0 | 68 | 92 | 170 | 0 | 13 | 92 | 0 | 0 | 0 | 20 |
| | T | 0 | 0 | 0 | 180 | | | | | | | | |
| Dec. | R | 170 | 0 | 42 | 75 | 51 | 0 | 5.3 | 75 | 0 | 0 | 0 | 26 |
| | T | 0 | 0 | 0 | 186 | | | | | | | | |

* Geometric Mean for 1986

Coliform Group - Count/100mL
Streptococcus Group Count/1mL

# APPENDIX D

# TERMS OF REFERENCE

## Purpose

To review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes.

## Work Tasks

1. Receive an information package from the MOE. Review the information provided and meet with the MOE staff, if required, to discuss the project.

2. Document the quality and quantity of raw and treated waters.

3. Define the present treatment processes and operating procedures. Prepare a progress report on Works Tasks 1-3 for the Project Committee.

4. Assess the methods of efficient particulate removal which would utilize the present major capital works of the plant. Evaluate the particulate removal efficiency and sensitivity of operation, assuming optimum performance of the plant.

5. Assess current disinfection practices and possible improvement methods.

6. Describe possible short and long-term process modifications to obtain optimum disinfection and contaminant removal.

7. Prepare a draft report for the project committee's review.

8. Prepare the final report.

2. DOCUMENT THE QUALITY AND QUANTITY OF RAW AND TREATED WATERS.

**Elements of Work**

(a) Prepare a monthly summary of maximum, minimum, and average flows for the last three consecutive years (Table 1.0). Address any discrepancies which exist between raw and treated flow rates.

(b) Based on the above, briefly review and tabulate for the last three years, the monthly maximum, minimum, and average per capita flow for the total population served by the plant (Table 1.1). Compare the plant data with typical per capita flows for the local region. Indicate major consumers who may influence the figures.

(c) Document the methods of measuring the raw and treated water flow rates.

(d) Summarize, for the last three consecutive years, where available, the raw and treated water; turbidity, colour, residual aluminum/iron, pH, temperature and treatment chemical dosages (other than disinfection and fluoridation). The summary should indicate the monthly daily average and maximum and minimum day (Table 2.0).

For the same three year period, tabulate also the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with particulate removal occurred (Tables 2). Document enough data to define and evaluate those problems.

Record other data, such as particulate counting, suspended solids, and algae counting (Table 5.0) which could reflect on particulate removal efficiency.

Document the source and methods used in determining all information.

A comparison should be made between the plant and outside laboratory information to ascertain the relative validity of the data. For plant data, emphasis should be given to plant laboratory tests rather than continuous process control instruments.

(e) Summarize for the last three consecutive years, where available, the disinfectant demand, dosages (including all disinfection related chemicals and residuals) for all application points as well as fluoridation dosage and residual. The summary should indicate the monthly daily average and maximum and minimum day (Table 3.0).

For the same three year period, tabulate (Tables 3) the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with chlorine residuals and/or positive bacterial tests identified in Table 6. Document enough data to define and evaluate those problems.

Document the methods of dosage evaluation and residual measurements, and establish the validity of the data provided.

(f) Prepare a summary, based on at least three years of data, of the raw and treated water quality testing data for physical, microbiological, radiological, and chemical water quality information (Table 4). Document as much data as is needed to show possible seasonal trends in water quality. Where possible, show corresponding sets of raw and treated water quality information.

Document the source and methods used in determining all water quality information and establish the validity of the data, comparing plant and outside laboratory data.

(g) Tabulate, for the last three consecutive years, the raw and treated water bacterial test information at the plant (Table 6).

Document the source and methods used for all data provided.

(h) Document the water sampling systems (source, pump, line-material and size, vertical rise velocity sampling location) used in the plant (similar to DWSP Questionnaire in Appendix A).

(i) Prepare a summary of inplant testing including Test, Sampling Point, Testing Frequency, Reporting Frequency, Testing Instrumentation including calibration.

(j) Identify other water quality concerns, not related to particulate removal or disinfection, which should be considered as part of the assessment phase of this evaluation program.

3. DEFINE THE PRESENT TREATMENT PROCESSES AND OPERATING PROCEDURES. PREPARE A PROGRESS REPORT ON WORK TASKS 1-3 (8 COPIES), FOR THE PROJECT COMMITTEE.

Elements of Work

(a) Where drawings are available, assemble sufficient record drawings of a reduced size, to document the general site layout and the interrelationship of major plant components. If available, include a process and piping diagram (PAPD) of the plant operations.

(b) Prepare a simplified block schematic of all major plant components including chemical systems and indicating design parameters. Appendix B is an example of the required standard schematic.

(c) Prepare a photographic record of the plant facilities, illustrating all of the major plant components and chemical feed systems. The record should include approximately 30-40 coloured (9 cm x 12 cm) (or 10 cm x 15 cm) prints, suitably labelled. The progress and draft reports may include photocopies in lieu of the prints.

(d) Tabulate the design parameters for all the major plant components, with emphasis on the process operations, including chemical feeds. This information, as a minimum, must be consistent with the DWSP Questionnaire (Appendix A) and must be confirmed and verified by field observations. The design parameters should be evaluated at design, rated and actual operational flows.

(e) Prepare a summary of how the plant is operated, including chemical dosage control, such as jar testing information, filter backwashing procedures and initiation, and pumping and flow control.

(f) Document all reported and other apparent problems in plant operations and/or in the distribution system related to water quality. In addition list the health related parameters which exceed the Ontario Drinking Water Objectives (Table 7).

(g) Submit 8 copies of the progress report to the Prime Consultant for distribution to the Project Committee.

4. ASSESS THE METHODS OF EFFICIENT PARTICULATE REMOVAL WHICH WOULD UTILIZE THE PRESENT MAJOR CAPITAL WORKS OF THE PLANT. EVALUATE THE PARTICULATE REMOVAL EFFICIENCY AND SENSITIVITY OF OPERATION, ASSUMING OPTIMUM PERFORMANCE OF THE PLANT.

Elements of Work

(a) Assess the validity and implication of all information relating to particulate removal provided in Work Tasks 1 and 2 with emphasis on method, metering and sampling, etc.

(b) Using information provided in Work Tasks 1, 2 and 3 evaluate the plant's particulate removal efficiency. The basis of minimum particulate removal should be 1.0 F.t.u. It should, however, be recognized that it is desirable to strive for an operational level which is as low as is achievable.

(c) Conduct an evaluation of possible optimum performance alternatives. Include jar testing using established industry practice.

(d) Evaluate the feasibility of optimum removal using the existing plant capital works. This evaluation should consider the worst case water quality conditions, even though field testing data may not be available during the initial phase of the study (see Work Task 7).

(e) Describe the operational procedures, management strategies, and equipment required for various feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation of the alternatives.

5. ASSESS CURRENT DISINFECTION PRACTICES AND POSSIBLE IMPROVEMENT METHODS.

Elements of Work

(a) Assess the validity and implication of all information relating to disinfection provided in Work Tasks 1, 2 and 3 with emphasis on method, metering and sampling etc.

(b) Using the information provided in Work Tasks 1, 2 and 3 evaluate the plant's ability to disinfect the water. The basis of minimum disinfection should be to ensure a water quality as described in the Ontario Drinking Water Objectives.

(c) Conduct an evaluation of possible optimum disinfection procedures for the plant, with consideration also given to the reduction of chlorinated by-products in the treated water.

(d) Evaluate the feasibility of the various alternatives using the existing plant capital works.

(e) Assess the relative merits of the alternatives. Describe the operational procedures, management strategies, and equipment required for the feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation for the alternatives.

6. DESCRIBE POSSIBLE SHORT AND LONG-TERM PROCESS MODIFICATIONS TO OBTAIN OPTIMUM DISINFECTION AND CONTAMINANT REMOVAL.

Elements of Work

(a) Prepare a list of modifications which should be considered for detailed implementation evaluation. Provide an estimated cost and possible schedule for implementation for each of the proposed modifications.

It is not the purpose of this study to provide a detailed implementation scheme for plant rehabilitation. It is, however, necessary to scope the feasible short and long-term process modifications required to achieve optimum disinfection and contaminant removals.

(b) Incorporate (a) above in the draft report.

7. PREPARE A DRAFT REPORT FOR THE PROJECT COMMITTEE'S REVIEW. (8 COPIES).

**Elements of Work**

(a) The report must include all information for Work Tasks 1-6.

The information must be organized and presented in a logical and co-ordinated fashion. A general table of contents (Appendix C) is provided for organizing the material in a manner consistent with other plant reports.

Submit the draft report for review by the Project Committee.

(b) Meet with the Project Committee on site at least one week after submission of the report.

(c) Prepare a separate letter report containing recommendation(s) concerning the need for additional field testing to cover quality conditions not available during the period of this study. The Project Committee may decide to delay completion of the final report until field data can be obtained to confirm the predictions of performance for the worst case water conditions.

8. PREPARE THE FINAL REPORT.

**Elements of Work**

(a) Conduct additional field testing if required. Discuss the implementations of the results with the Project Committee if the results differ from the predicted performance.

(b) Amend the report as per review comments, incorporating additional field data if required.

(c) Submit 25 copies of the final reports (including the colour photographs) to the MOE for distribution.